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WASTEWATER MANAGEMENT STUDY FOR CLEVELAND - AKRON METROPOLITAN --ETC(U).
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WASTEWATER MANAGEMENT STUDY

SUMMARY REPORT

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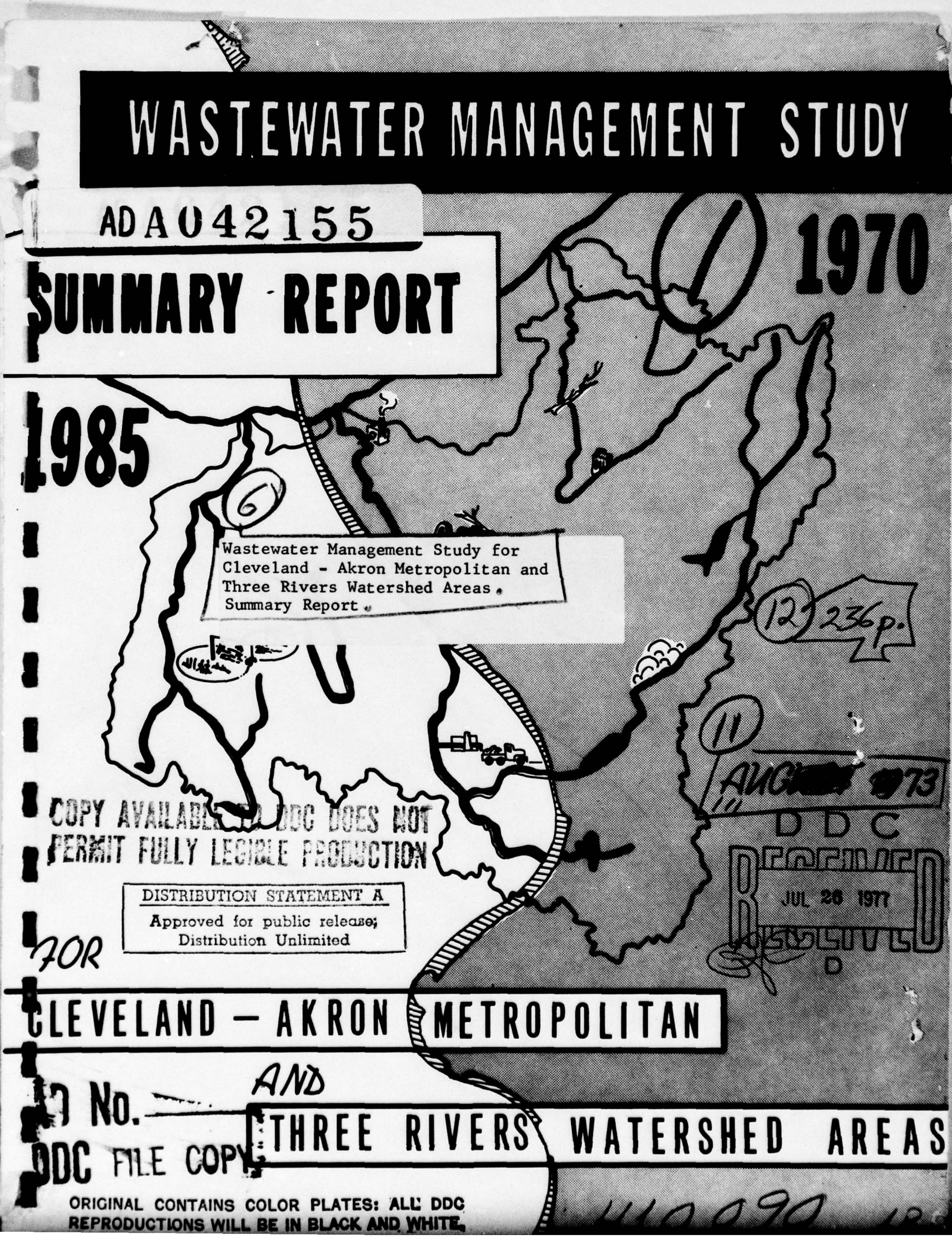

Wastewater Management Study for
Cleveland - Akron Metropolitan and
Three Rivers Watershed Areas.
Summary Report.

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AUGUST 1973

FOR

CLEVELAND – AKRON METROPOLITAN

AND

THREE RIVERS WATERSHED AREAS

410 990

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IV	Industrial Wastewater, Associated Water and Air Resources Engineers, Inc.
V	Land Treatment, Wright-McLaughlin Engineers
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CHAPTER 1

INTRODUCTION

A. Purpose

This study is concerned with the formulation, design, and assessment of the impacts of alternative plans for area-wide wastewater management for the Cleveland-Akron Metropolitan and Three Rivers Watershed Areas in Northern Ohio. The basic wastewater sources considered in the study are municipal sewage, industrial waste flows, and combined and separate urban stormwater runoff. During this study, the Corps of Engineers examined a wide range of advanced wastewater treatment technologies, formulated alternative plans to achieve a range of effluent water quality goals, and, for four selected alternative plans, illustrated how implementation would be phased in accordance with guidelines established by the Federal Water Pollution Control Act, Amendments of 1972, enacted October 18, 1972 (Public Law 92-500). The findings of this study, displayed in this report, are intended to be used, primarily, by the State of Ohio and the people in the affected areas to help them select an effective water quality management program. The findings may also assist the Federal Environmental Protection Agency in its review and approval of proposed Ohio water quality standards and plans.

This report extends the wastewater treatment planning effort provided by the Northeast Ohio Water Development Plan (draft distributed, November 1971) by:

1. examining various advanced wastewater treatment technologies;

2. examining systems for the collection and treatment of urban stormwater runoff;

3. designing systems to achieve a range of high effluent quality; and

4. phasing the implementation of the alternative plans in accordance with the guidelines established by PL 92-500.

The planning aspects of the Northeast Ohio Water Development Plan include water supply, flood control, and recreation objectives. This wastewater study does not specifically address all of these, but does provide an analysis of wastewater systems that complement these objectives and make them more readily attainable. The Northeast Ohio Water Development Plan also encompasses a larger area than the wastewater study by including the Grand and Ashtabula Rivers tributary to Lake Erie and the Mahoning River and Pymatuning, Yankee, and Little Beaver Creeks tributary to the Ohio River. Central to the objectives of the Northeast Ohio Water Development Plan, defined by the Ohio Water Commission, was ".... to provide the most cost effective abatement strategy, considering social and environmental factors, for protecting existing and projected water uses and to prevent degradation of the existing high quality waters." The alternative plans discussed in this summary report have been based upon the foundation laid by the Northeast Ohio Water Development Plan while

expanding upon the technologies and some of the problem areas considered in that plan.

B. Authorities

The overall authority for this study is contained in Section 102 of the Rivers and Harbors Act of 1966 (Public Law 89-789). This act called for a study of the Great Lakes, particularly Lake Ontario and Lake Erie. The scope of the overall study includes water resource needs and problems concerning water supply, pollution abatement, navigation, and flood control.

The specific authority for the detailed survey study for wastewater systems for the Cleveland-Akron Area comes from two Congressional resolutions. The House of Representatives, on 10 November 1971, and the U. S. Senate on 23 November 1971, passed similar resolutions calling for a detailed investigation of alternative systems for wastewater management for this area. This effort was to be carried out in close cooperation with the Federal Environmental Protection Agency and State and local pollution control and environmental planning agencies.

Public Law 92-500, because it established national water quality policies, goals, and objectives, provides supplemental guidance for this study. This law recognized the right of the State to execute water resource planning and suggested that the Corps of Engineers could provide the planning upon request by the State (Section 208). The Corps planning effort is then in support of the State's need and desire to have a viable wastewater management plan for the Three Rivers Watershed. These basic roles of the Corps and the State are most important

to understand and have a definite impact on the conclusions and recommendations of this report. Buffalo District staff compiled the conclusions in Chapter 9 considering the input of the State of Ohio and local citizens as well as contractors' work. The State of Ohio developed the recommendations in Chapter 10 during its review of the study results including technical and public contributions. The Corps of Engineers considers its participation in wastewater management to be one of planning with no involvement in design and construction.

Public Law 92-500 provides the guidance for time-phasing the final alternatives to achieve the desired Federal pollution goals. The law specifies the following (Section 301): "... there shall be achieved -

"(1) (A) not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, ... the application of the best practicable control technology currently available as defined by the Administrator ...

"(B) for publicly owned treatment works in existence on July 1, 1977, ... effluent limitations based upon secondary treatment as defined by the Administrator ...

"(2) (A) not later than July 1, 1983, effluent limitations for categories and classes of point sources, the application of the best available waste treatment technology ... toward the national goal of eliminating the discharge of all pollutants ..." Section 101 states that "it is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985."

A closely related study of measures to improve and restore the environmental quality of the Cuyahoga River Basin was authorized in Section 108 of the Rivers and Harbors Act of 1970 (P.L. 91-611). The Cuyahoga River Restoration Study is being funded separately from this study because specific Federal water resource projects are under investigation. Nevertheless, there is a high degree of interdependence and common purpose between the wastewater management study and the Cuyahoga River Restoration Study. Therefore the authority is cited here as additional guidance for the Wastewater Study.

C. Study Evolution

Early in this century water quality management was concerned with methods to control public health meances, such as typhoid fever and cholera. By 1920, technologies to reduce these and other menances were known and had begun to be used. Since that time, increased affluence and leisure time has helped broaden the focus of water quality management toward further improvement of our water resources. Today, society is demanding that our waters be fit for recreational uses and also be pleasing to sight and smell.

Water quality laws and regulations have matched this change in focus by expanding from drinking water standards to stream quality standards. This represents a broader water use emphasis. At the same time, responsibility for water quality programs has been moved from public health agencies to more broadly based water pollution, water

resource, or environmental control agencies. The best example of this transition has been the creation of the Federal Environmental Protection Agency in late 1970.

There have been many State, Federal, and International studies that focus on determining the magnitude and extent of water quality problems. In addition, there is an extensive amount of sponsored research and many demonstration projects and programs designed to develop an expanded technology as well as a better use of technology for wastewater management. The United States-Canadian Great Lakes Water Quality Agreement of 1972 was brought about by the recognition of a water quality problem common to both countries. This agreement establishes objectives, defines some of the elements to be contained in pollution control programs, gives the International Joint Commission (IJC) a specific coordination and information role, and provides a mechanism for the IJC to make studies of water quality problems upon specific request.

As these expansions, changes, and investigations have taken place, there has been a growing recognition of the need for coordinated planning in water quality management. The State of Ohio recognized the need for broadly-based water resource planning in the late 1950's and provided the enabling Watershed District legislation in the early 1960's. In January 1971, the United States Environmental Protection Agency (EPA) issued guidance establishing planning criteria for the States,

emphasizing regional and river basin water quality programs. In order to emphasize the importance of this type of planning, the EPA regulations specified that after 1 July 1973, construction grants for specific water pollution control facilities would not be approved unless they were part of and compatible with State approved plans.

These efforts have definitely improved this nation's capability to deal with water quality problems. However, the implementation of solutions is still moving more slowly than the growth of these problems in most parts of the country. This is due, in part, to the fact that we are creating new products and expanding our urban communities faster than we are increasing our knowledge of the effects of these changes. There is a definite need to expand the level of our water quality programs to try to control the adverse impacts on water quality of that growth. In addition to the single objective of water quality improvement, we must consider others such as water reuse and constituent recycling. We must expand our technological choices to allow these objectives to be given full consideration. We must also continue the trend to view these issues on a regional or area-wide basis.

The Corps of Engineers Pilot Wastewater Management Program was designed to investigate these broader aspects and objectives. This program was approved by the Office of Management and Budget late in 1970 and by the Public Works and Appropriations Committees of Congress.

Five feasibility studies and one detailed survey study were undertaken. One of the feasibility studies was for the Cleveland-Akron Metropolitan and Three Rivers Watershed Areas. Feasibility studies were: to determine the magnitude and extent of area-wide problems; to determine the feasibility of regional systems designed to meet constituent recycling, water re-use, and water quality improvement; and to display an appropriate range of alternative systems. that should be considered in more detail. These studies were conducted under a memorandum of understanding with the U. S. Environmental Protection Agency and were coordinated with the affected States.

Conclusions reached by the Chief of Engineers as a result of the feasibility studies were that:

1. Because of the magnitude of current and projected wastewater problems, regional or area-wide systems designed to meet the objectives of constituent recycling, water reuse, and water quality improvement must be given serious attention;

2. There are several technological options that can be used alone or in combination to provide effective systems to meet these three objectives: and

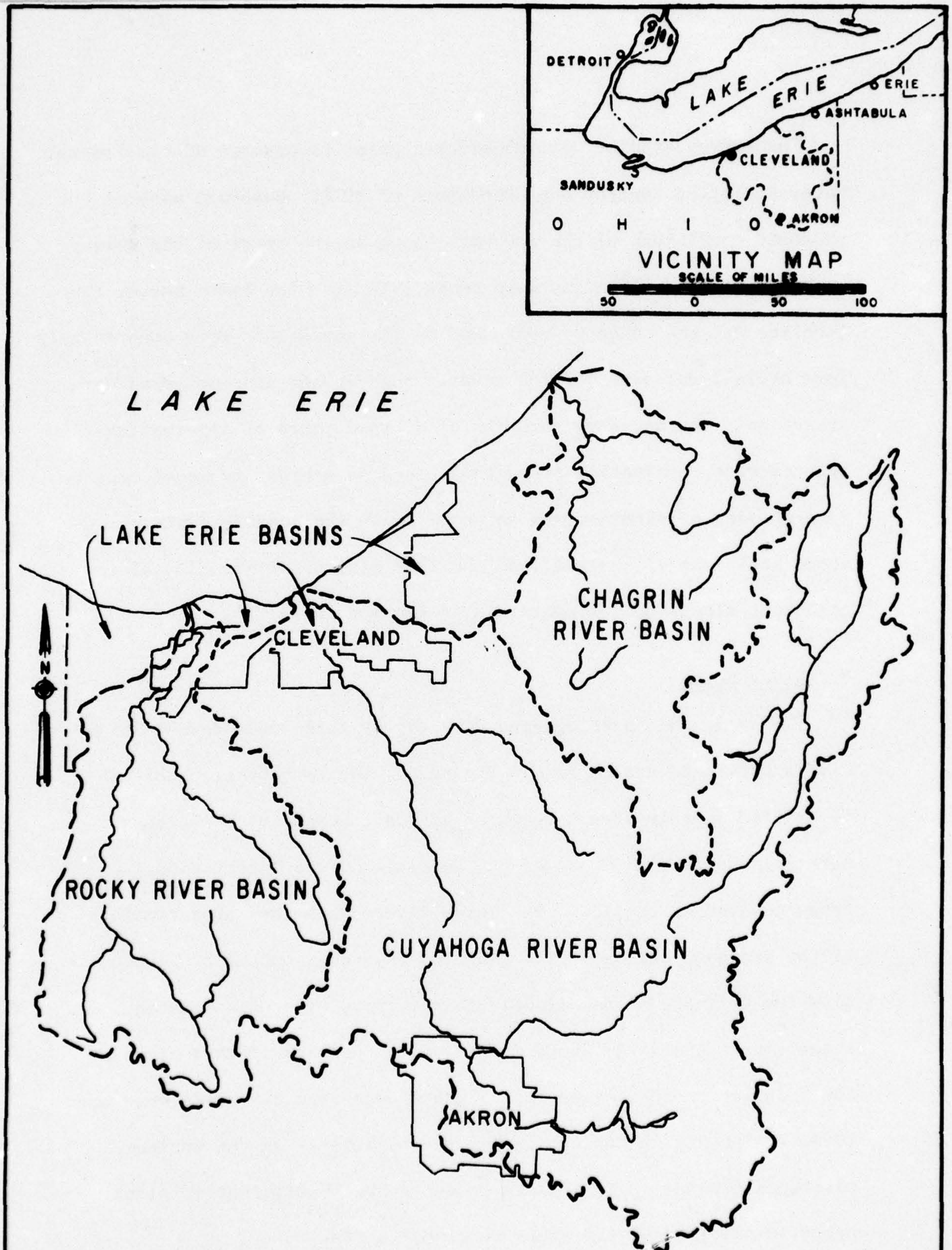
3. All alternative systems must be evaluated in terms of economics, social effects, environmental impacts, and institutional effects.

Based on the feasibility studies, Congress authorized the detailed survey studies as noted in Section B and appropriated funds to carry them out.

The survey studies were undertaken prior to passage of the Federal Water Pollution Control Act Amendments of 1972. However, many of the proposed provisions of the law were known as the start of the survey studies. These provisions were compatible with the basic survey objectives and the concepts contained in the amendments were used to help form overall guidance for the study. Some of the concepts used were area-wide planning, consideration of a broad range of alternative technologies, evaluation of systems based on a broad range of impacts, time-phasing of alternatives to comply with the interim goals of reduced pollutant discharges, and the 1985 goal of elimination of pollutant discharges as contained in Section 101(a)(1).

D. Study Scope

The geographic area covered directly by this study is the Three Rivers Watershed area shown in Figure 1. The wastewater problems identified in this area have an effect on the rest of Ohio, the Lake Erie Region, the rest of the Nation, and the International areas covered by the IJC. The Three Rivers Watershed area consists of the drainage basins of the Chagrin, Cuyahoga, and Rocky Rivers, plus the drainage areas directly tributory to Lake Erie between these rivers and in Cuyahoga County. For purposes of this study, the existing and estimated future wasteloads from this area were used to determine design capacities for the facilities in the various alternative plans. The impacts produced by the alternative plans occur in all five of the areas mentioned above.



THE THREE RIVERS WATERSHED

FIGURE 1

The functional scope of the study emphasized the formulation, design, and impact assessment of wastewater management systems for the problem area. This included measurement of impacts on water quality, water reuse, and constituent recycling. Impacts on other water resource needs and problems were determined in quantitative terms where possible, if the impacts would have a bearing on the decision-making process.

For everyone to have an understanding of the level of design detail used in this study, it is necessary to define the term "survey scope study." A survey scope study or investigation is one that develops sufficient design and evaluation details to allow a choice to be made from among alternatives. It does not, however, provide detailed design data sufficient to initiate the construction of a project or projects.

E. Participation and Coordination

Several Federal agencies were involved and participated in the study through an Interagency Coordinating Committee and on an individual basis. The Federal representatives to the Interagency Committee included the U. S. Environmental Protection Agency, the Soil Conservation Service of the U. S. Department of Agriculture, the Department of Housing and Urban Development, and the Department of the Interior. These agencies provided information and comment on specific plans. Through the Interagency Committee these reactions and comments were used as an aid in the formulation of initial alternatives as well as the later screening process.

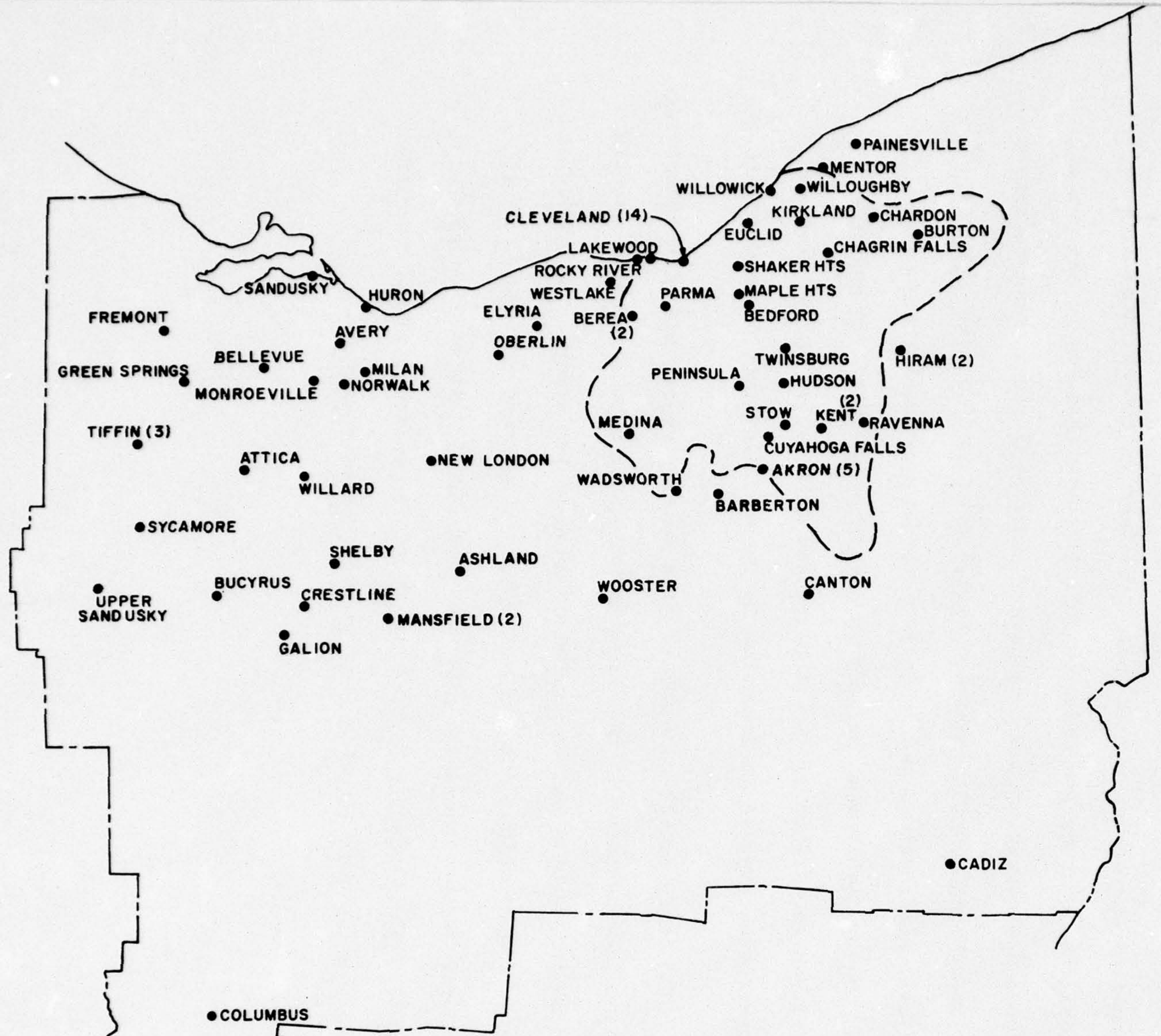
During the feasibility study and the early stages of the survey study, participation by the State of Ohio was also one of information input and comment. As the survey study progressed, the State of Ohio involvement in the planning decisions increased significantly. The State was instrumental in selecting the alternatives to be carried into detailed studies during the final screening process. State representatives on the Interagency Coordinating Committee included the Ohio Department of Health, the Ohio Department of Natural Resources, the Ohio Department of Development, and the Ohio Environmental Protection Agency.

Two intra-state agencies were also members of the Interagency Coordinating Committee. They are the Northeast Ohio Areawide Coordinating Agency and the Three Rivers Watershed District. These organizations played an important part in the formulation of plans along with the rest of the Interagency Committee. For the most part, the active involvement of most local agencies consisted of inputs of basic information and comment on specific alternatives. The Three Rivers Watershed District was the lead group representing local interests and it actively participated in the majority of the public meetings and workshops.

The general public and other interested groups were involved in the study through a series of public meetings, informal workshops, and seminars or presentations conducted during the course of the study.

In addition, the "Purewater Press," a periodic newsletter, was used as the principal public communication medium during the plan formulation phases of the study. These tools were used to inform interested people about study progress, to solicit their reaction to any and all proposed alternatives, and to gather additional pertinent information. The reactions and information obtained were used to help form the initial alternatives and to help in the later screening process. The public involvement program is described in detail in Appendix VIII and the effect of the reaction and information on the plan formulation process is described in Chapter 5 of this summary report.

The study report consists of this summary report and nine supporting appendices as noted in the Table of Contents. The appendices contain extensive details and backup information on the study. The appendices have been distributed to public libraries and many offices of local government throughout the affected study area. Figure 2 shows the towns where libraries have copies of the appendices. These libraries are indicated in Attachment A to this summary report.



LIBRARY LOCATIONS FOR FULL
DRAFT OF WASTEWATER STUDY

FIGURE 2

CHAPTER 2

THE PLANNING GOALS AND PROCESSES

A. Goals and Objectives

On April 15, 1972, President Nixon and Prime Minister Trudeau signed the U. S.-Canadian Great Lakes Water Quality Agreement. The general goals of this agreement are to restore and enhance the water quality of the International Great Lakes and to prevent further pollution as a result of population growth, resources development, or increased water use.

The agreement describes some general water quality objectives that have been characterized as the five freedoms of water quality. These state that the waters of the Great Lakes should be:

1. Free from substances that will settle to form putrescent or otherwise objectionable sludge deposits or that will adversely affect aquatic life or waterfowl;

2. Free from floating debris, oil, scum, or other floating materials in amounts sufficient to be unsightly or deleterious;

3. Free from materials producing color, odor, or other conditions in such a degree as to create a nuisance;

4. Free from substances in concentrations that are toxic to human, animal, or aquatic life; and

5. Free from nutrients in concentrations that create nuisance growths of aquatic weeds and algae.

In addition to these general goals and objectives, the agreement spells out eight specific water quality objectives for the Great Lakes. This list includes specific limits covering microbiology, dissolved oxygen, total dissolved solids, taste and odor, pH, iron, phosphorus, and radioactivity. The agreement also specifies five interim objectives to be used until more specific limits can be determined. The items covered include temperature, mercury and other toxic heavy metals, persistent organic contaminants, settleable and suspended materials, oil petrochemicals and immiscible substances. The agreement also includes a non-degradation clause and provides for further study on 18 specific constituents or substances.

Finally, the agreement outlines some specific program objectives and guidance. It specifies that programs and measures for Great Lakes water quality improvement shall either be completed or in the process of implementation by December 31, 1975. Some of the specific areas that are to be incorporated into water quality programs include control of eutrophication and pollution from municipal and industrial sources; agriculture, forestry, and other land use activities; shipping and dredging activities; and onshore and offshore facilities. In addition, the programs should provide for the development of a joint contingency plan and the identification and control of hazardous polluting substances.

As noted in Chapter 1, the Federal Water Pollution Control Act Amendments of 1972 became law on October 18, 1972. These Amendments

establish goals, objectives, and programs for the improvement of water quality in the United States. One of the goals is the elimination of the discharge of pollutants into navigable waters by 1985. The Amendments also provide an interim goal to achieve water quality that provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water by July 1, 1983.

The new Amendments also provide several general and specific objectives. Three of the most significant objectives pertinent for this study are that discharge of toxic pollutants in toxic amounts shall be prohibited, that public participation in water quality programs shall be encouraged, and that water quality programs shall emphasize the reduction and elimination of duplication of effort.

There are several objectives in the Amendments that relate to comprehensive regional planning. The first is the objective that wastewater management planning be carried out on an area-wide basis wherever possible. The second planning objective is that wastewater management programs be designed to control and treat all sources of wastes including point sources, non-point sources, and in-place or accumulated sources. The third objective pertinent for this study is that wastewater management plans must be developed for waste treatment needs in the study area for a 20-year period.

The Amendments do not stop with planning objectives, but set forth some specific design objectives. One of these is that wastewater management systems that result in the construction of multiple-purpose

or integrated revenue-producing facilities shall be encouraged. A second design objective is that these systems shall provide for the treatment and recycling of potential sewage constituents to promote the production of agricultural, silvacultural, aquacultural, or combination products, to provide for the confinement and containment of unrecycled constituents, to provide for the reclamation of wastewater, and to provide for the ultimate disposal of sludge without environmental hazard. These facilities shall also provide measures to dissipate or use waste heat or thermal discharges. In the design, construction, and operation of these facilities, provisions for open space planning will be considered, and account will be taken of recreation potentials.

In the evaluation process the goals and objectives articulated by Interstate organizations, State agencies, and local governments were compiled. Most of these goals and objectives related to wastewater management are very similar to those noted above. There are five additional regional goals that can be added to this list. They are:

1. To provide an effective flood management program incorporating flood plain management practices as well as flood control measures, when necessary.

2. To provide an effective and uniform air pollution control program that would include standards, enforcement, and specific facilities where needed.

3. To provide an effective program for land use planning incorporating open space considerations that would include the type and location of public services such as wastewater management facilities.

4. To maintain and improve the area's competitive economic position through planned early development.

5. To provide a variety of employment as well as enjoyment opportunities for area residents.

These lists of international, national, interstate, State, and local goals and objectives described above represent the regional planning objectives considered pertinent to this study.

B. Specific Study Objectives

Specific objectives for the conduct of the Cleveland-Akron Metropolitan and Three Rivers Watershed Study were developed from four basic sources. The first source came from the directives within the Federal system starting with the initial approval of the pilot program through the House and Senate Resolutions of 1971, and finally with the issuance of study guidance in May 1972. The second source of guidance came from the Northeast Ohio Water Development Plan. The U. S.-Canadian Great Lakes Water Quality Agreement was the third source of guidance on policy and objectives, and the Federal Water Pollution Control Act Amendments of 1972 was the fourth source. Seven basic study objectives were formulated and modified from these sources as the agreement and the amendments became reality.

The specific objectives formulated for this study are:

1. To continue wastewater management planning on a regional scale, demonstrated as practical in the Northeast Ohio Water Development Plan and supported by the Wastewater Management Feasibility Report, Alternatives for Managing Wastewater.

2. To develop wastewater management plans in harmony with the short range plans of the localities within the region. Local plans scheduled for implementation prior to 1975 are considered fixed.

3. To identify opportunities for reuse of treated water and recycling of extracted residuals, and to develop alternative plans to take advantage of these opportunities.

4. To insure that all alternative plans contribute as much as possible to the environmental quality and social well-being of all areas on which they impact.

5. To comply with the goals, objectives, and program guidance of the Great Lakes Water Quality Agreement of 1972 as they relate to municipal and industrial wastewaters and urban stormwater runoff.

6. To comply with the goals, objectives, and guidance contained in the Federal Water Pollution Control Amendments of 1972 as noted in Section A of this chapter.

7. To provide a range of alternatives in the final phase that will display the impacts of systems designed to achieve existing criteria as well as the higher goals or criteria cited in the new

Amendments. These alternatives were developed to facilitate the comparison of area-wide systems incorporating various technologies to treat all waterborne waste sources.

As indicated in Objective 1, the Northeast Ohio Water Development Study represents a practical demonstration of regional water resources planning in Northern Ohio. The plan specifically displays a wastewater management plan to meet State standards. Those standards appear in Attachment B. This plan provides a substantial base on which to build alternatives designed to meet higher effluent quality criteria. The Corps modified this plan by including the collection and treatment of urban stormwater runoff and upgrading effluent quality. This modified Northeast Ohio Water Development Plan became the first alternative system considered in this study.

The objectives of this Wastewater Management Study explicitly require the use of at least two sets of design criteria, one set for existing standards and one designed to achieve 1985 goals.

New effluent standards for the Mahoning River Basin have been adopted by the Ohio Pollution Control Board and approved by the U. S. Environmental Protection Agency. The Ohio EPA began hearings in March 1973 to consider the adoption of very similar State-wide standards. Those standards have not yet been finalized. For purposes of this study, it was assumed that these proposed Ohio standards will be adopted in the near future. A set of criteria based on these proposed standards was adopted for the study and called Level I criteria. It is believed that this set of criteria would approach the interim 1983 goal for best practical technology.

Level I criteria, in most cases, used values close to the most severe end of the range of values of the Mahoning River standards, with the exception of heavy metals. For these constituents, the Level I criteria would require wastes containing metals to be treated to the level achievable with the best practical technology. The comparison of Ohio standards used for the Mahoning River and Level I criteria is shown in Table 1.

TABLE 1
Comparison of Example Criteria
Ohio and Level I

CONSTITUENT	OHIO STANDARDS - MAHONING RIVER	LEVEL I
	(Milligrams per liter)	
Suspended Solids	5-30 Dependent on Season And Dilution	8
Biochemical Oxygen Demand	5-30 Dependent on Season And Dilution	5
Phosphorous	1	0.5
Ammonia Nitrogen	2-10 Dependent on Season And Dilution	2
Total Dissolved Solids	500	500
Heavy Metals	0.005-5.0 Dependent on Chemical Species	Best Practical Treatment

Public Law 92-500 established the goal that "...the discharge of pollutants into the navigable waters be eliminated by 1985." The criteria or standards required to achieve this goal have not, as

yet, been defined by the Federal EPA. In order to establish technical criteria for use in this study, the Corps estimated technical goals commensurate with the national goal, that would:

1. Prevent the continued degradation of water resources by waterborne wastes; and

2. Provide for the efficient reuse of treated or renovated wastewater and by-products.

The Office, Chief of Engineers (OCE) translated these technical goals into effluent criteria consisting of the most severe constituent levels from among those required for public water supply, irrigation water, livestock water, and aquatic habitat. These criteria, referred to in the report as the OCE goals, were established based on an extensive search of literature concerned with water quality and drinking water standards. These goals should not be interrupted as effluent standards established by the Federal Government. Rather, they represent a translation, by the Corps of Engineers, of the stated national goal into a set of consistent guidelines to be used for Corps Pilot Wastewater Management Studies throughout the nation. It is anticipated that specific criteria will eventually be established to meet the national goal. Since the OCE goals consist of the most severe constituent levels for water usage, they should approach the anticipated criteria.

During the initial phases of the study it was determined that treatment works could be designed to assure the effluent criteria

developed by OCE at least 90 percent of the time. Therefore, a set of criteria that could be achieved essentially all of the time was developed. These criteria were slightly less severe than OCE goals. This set of criteria, called Level II criteria, was used for this study. The treatment facilities developed in this study will meet the OCE goals 90 percent of the time, and Level II criteria essentially all of the time. No measurable impact differentials between use of the OCE goals and the Level II criteria could be found. As in the case of Level I criteria, the Level II criteria for heavy metals is that which can be met using the best practical technology. The comparison of OCE goals with Level II criteria is shown in Table 2.

TABLE 2
Comparison of Example Criteria
OCE and Level II

CONSTITUENT	OCE GOALS	LEVEL II
	(Milligrams per liter)	
Suspended Solids	2	5
Biochemical Oxygen Demand	2	5
Phosphorous	0.05 as PO_4	0.5 (1.5 as PO_4)
Ammonia Nitrogen	0.1	1
Total Dissolved Solids	500	500
Heavy Metals	Absent	Best Practical Treatment

C. Planning Process

The planning program for this study is being carried out using a repetitive, four phase process that began with the feasibility

study and will end when the State of Ohio receives approval from the Federal EPA on an area-wide wastewater management system for the Three Rivers Watershed Area. The four phases consist of the feasibility study, the search for alternatives, the reduction and analysis of the best alternatives, and the final selection of a area-wide wastewater management system by the State of Ohio and the Federal EPA. The framework used as an outline for the development of the best alternatives consists of seven steps or activities. These are to:

1. Identify existing and future pollution loads.
2. Develop alternative wastewater management systems;
3. Evaluate the alternative systems;
4. Identify the best alternatives;
5. Study institutional factors and impacts;
6. Develop an early-action program; and
7. Maintain close State and local cooperation.

The sixth step, to develop an early-action program, was not a significant activity until the third phase, and it will become even more significant during the fourth phase, which cannot be completed until after this report is submitted.

The major features of each phase are summarized briefly below.

1. Feasibility Study - The report entitled Alternatives for Managing Wastewater was completed and published in July 1971. This study used the best available data and examined a representative array of regional wastewater management systems designed to achieve a high

degree of water quality. The Feasibility Study was soundly founded upon the available data and took into consideration the problem resolution proposed in the Northeast Ohio Water Development Plan for the Three Rivers Watershed Area. It was determined in the Feasibility Study that there were several available technologies that could be used alone or in combination to satisfy, on a regional basis, the wastewater management needs of the study area.

2. Search for Alternatives - The basic goals of this phase were to fill critical information gaps discovered during the first phase and to delineate a wide range of feasible alternatives sufficient to examine and evaluate the available technologies in greater detail. Several alternatives were developed using both Level I and Level II criteria. These were modified and adjusted during the formulation process to attempt to take advantage of water reuse and constituent recycling. The formulation and evaluation processes are described in additional detail in Chapter 5, and the 12 alternatives that were developed are described in Chapter 6.

3. Reduction and Analysis of the Best Alternatives - The third phase began by screening the 12 alternatives to select the best ones for more detailed analysis and design. This screening process was done with the help and cooperation of the Interagency Coordinating Committee, the State of Ohio, and the public, through a series of informal meetings and workshops. Chapter 7 contains the description of the final alternatives and their evaluation.

4. Selection of the Best Alternative - This phase will be carried

out by the State of Ohio and the Federal EPA, and consists of reviewing the Northeast Ohio Water Development Plan as related to the Three Rivers Watershed area and comparing that plan to the design and evaluation of the alternatives developed in Phases 2 and 3 described above. After this review and any modifications deemed necessary, the State and Federal EPA, guided by public opinion, will agree on and select a wastewater management plan for the study area. The selected plan may not be exactly as one described in this report, but may be an alteration of the same basic components. That decision must be made by the State of Ohio.

In order to be of the most use to the State of Ohio and the Federal EPA in making necessary decisions and approvals, the analyses of this study have been developed to comply with Public Law 92-500 by providing plans that:

1. consider all wastes generated within the area.

2. study and evaluate alternative treatment management technologies.

3. provide treatment facilities to handle anticipated municipal and industrial wastewaters and urban stormwater runoff.

4. identify the capital and operation and maintenance costs for each alternative plan.

5. identify the proportion of the construction and operation and maintenance costs of municipal facilities directly attributable to industrial wastewater contributions.

6. identify the economic, social, and environmental impacts of

carrying out each alternative plan.

7. identify beneficial uses of residuals and/or disposal methods not detrimental to water quality.

8. provide a schedule of phased implementation of the final alternative plans to approach the national goal of eliminating the discharge of pollutants into navigable waterways by 1985.

The plans have also been developed to comply with the Great Lakes Water Quality Agreement of 1972 as it relates to municipal and industrial wastewaters and urban stormwater runoff.

In this way, the best alternatives as developed in this report provide a means of comparison between alternatives of costs and impacts for various treatment technologies and treatment levels.

CHAPTER 3

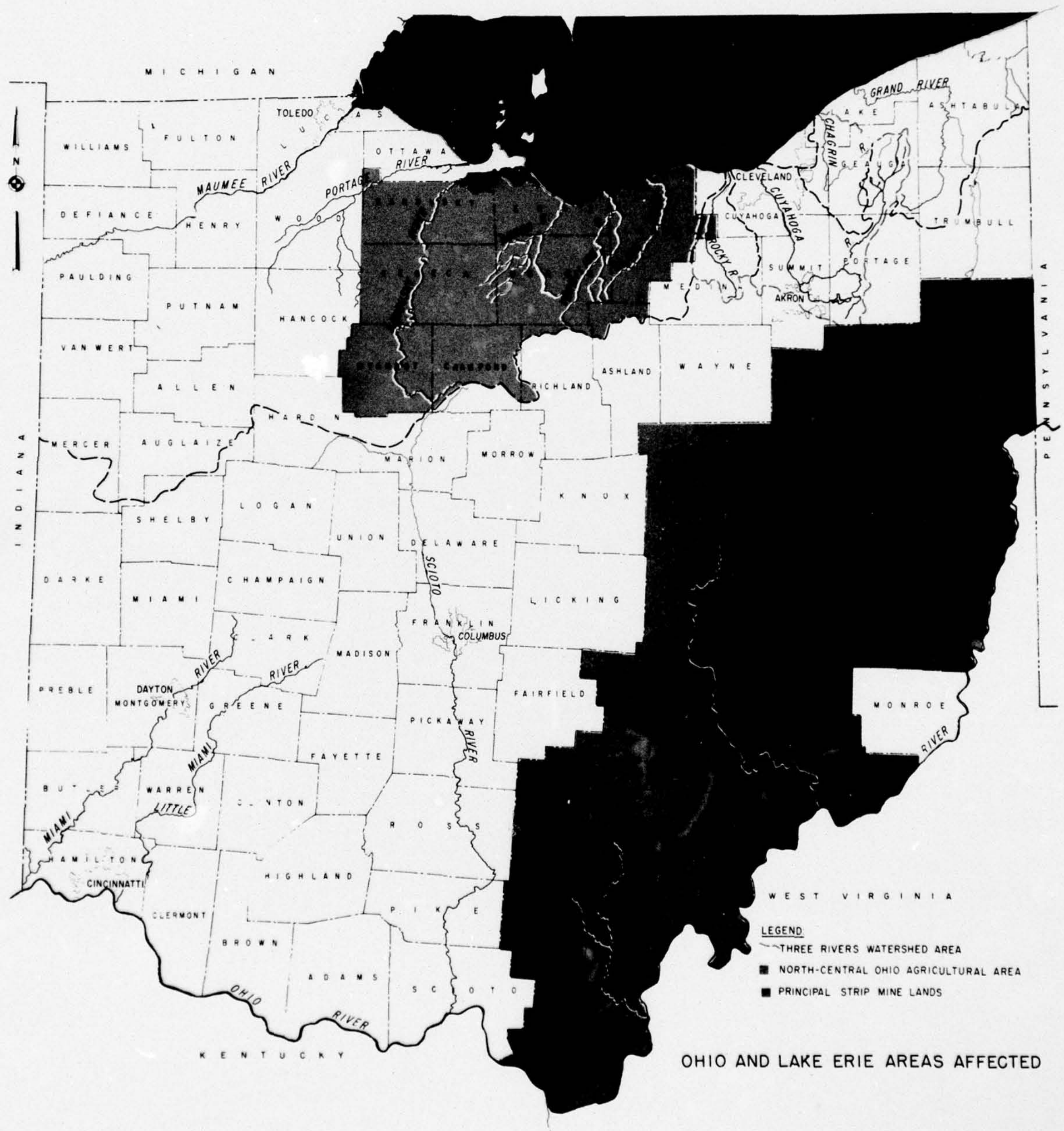
THE STUDY AREA

A. Physical Description

The study area consists principally of the Three Rivers Watershed. The problems identified in this area have an effect on the rest of Ohio, the Lake Erie Region, the rest of the Nation, and the International areas of the Great Lakes. For this study, the wastewater sources are limited to those generated in the Three Rivers Watershed area. Each of the wastewater management alternatives has an impact on this "source" area and on one or more of the other four areas as well. Some portions of these areas are more pertinent than others in terms of specific impacts. These additional affected areas include the agricultural area to the west of the source area, the Appalachian region to the southeast, and Lake Erie proper. The areas are shown in Figure 3. A general description of the topography, climate, etc., is made for all the areas because of the impacts on each area. Much more detail is included on the Three Rivers Watershed.

1. The Source Area.

The source area consists of three river systems, the Chagrin, the Cuyahoga, and the Rocky. In addition, there are several small streams that drain directly into Lake Erie. The study area was also extended to the west to include all of Cuyahoga County. The



OHIO AND LAKE ERIE AREAS AFFECTED

headwaters of the main rivers lie along the St. Lawrence-Mississippi divide, and the rivers flow generally northward to Lake Erie.

Approximately 23 percent of the area's 1,500 square miles are presently urbanized. Cleveland, with a population of over 750,000, is the largest urban center in Ohio, one of the nation's largest industrial cities, and one of the largest Great Lakes' ports. Industrial products manufactured in the area include steel, automotive products, machine tools, petroleum products, chemicals, rubber goods, and wearing apparel. Akron, with a population of over 275,000, is a major tire and rubber center and the fifth largest city in Ohio.

2. The Affected Areas.

The Three Rivers Watershed is part of a larger, Cleveland-oriented region consisting of the 30 counties of Northeast Ohio and five counties of Northwest Pennsylvania. This larger region contains about 5.6 million people on 17,000 square miles of area.

The western portion of the larger region is comprised of nine counties, lying principally within the drainage of the Vermilion, Huron, and Sandusky Rivers. That area contains an abundance of rich agricultural soils. Approximately 89 percent of the land is used for agriculture. Although agricultural activity dominates the area's general character, the economic base is diversified.

The northern extreme of the Ohio portion of Appalachia lies approximately 100 miles south of Cleveland. That 28-county area

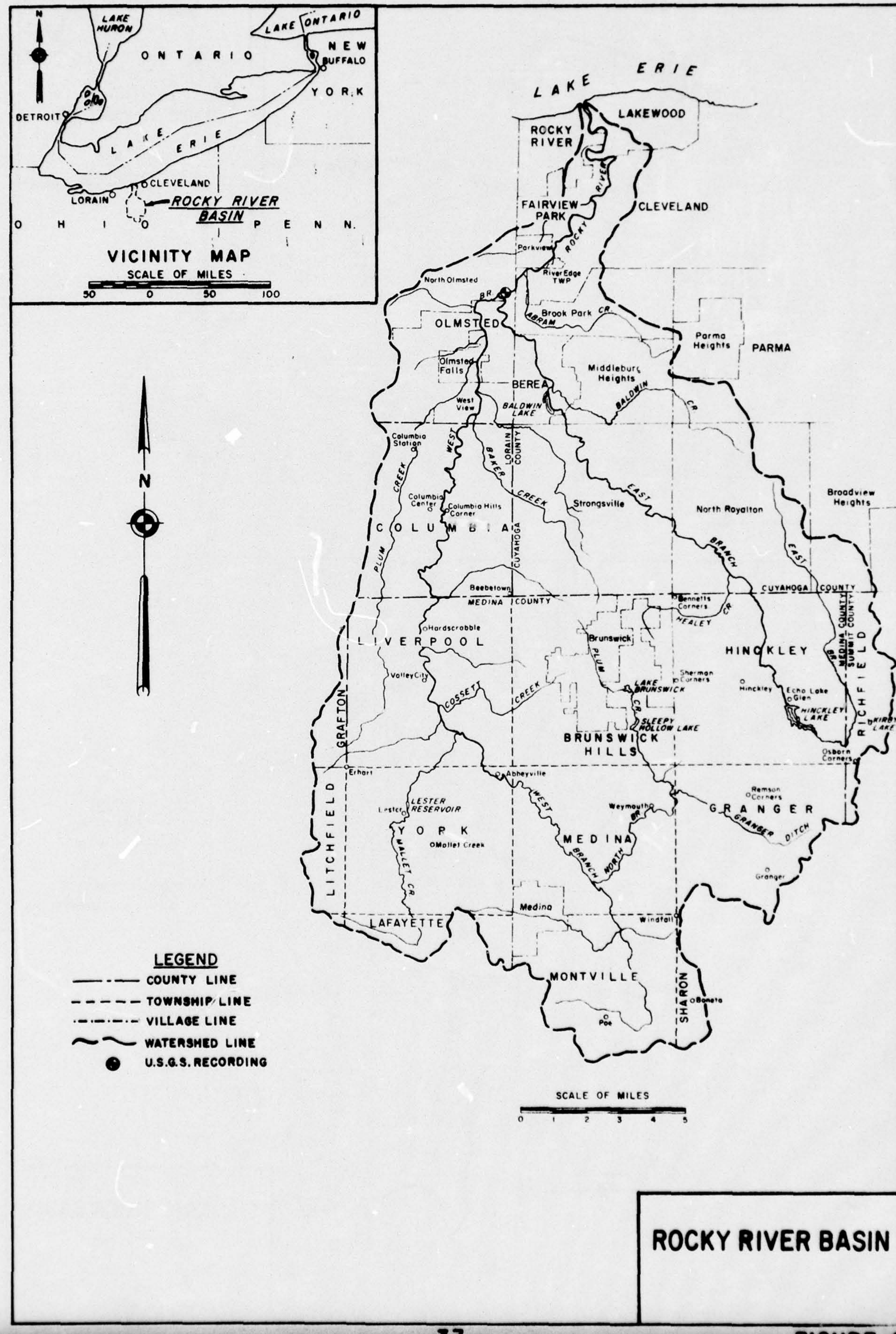
shares many of the basic physical and social problems that characterize Appalachia. The more critical physical problems are sedimentation and acid mine drainage that cause streams to be devoid of vegetation and fish life. The basic causes of these problems are overcutting of timber and strip-mining. Principal social problems include lack of communications, poor health care and education, poor diet and housing, and economic depression.

The thirteen northernmost Appalachian counties lie principally within the Muskingum River Drainage Basin, a tributary to the Ohio River. This area contains nearly 300,000 acres of strip-mined land, approximately 7 percent of the area. This strip-mined land provides a unique opportunity for the re-use of wastewater bi-products through land rehabilitation and return to productivity.

3. Source Area Details.

The Rocky River Basin, shown in Figure 4, is the westernmost of the three rivers and drains an area of 294 square miles in Medina, Summit, Lorain, and Cuyahoga Counties. The two branches join at North Olmstead, flowing north to Lake Erie in a single narrow, steep-walled valley. Most of the East Branch and the main stem flow through the Rocky River Reservation of the Cleveland Metropolitan Park System.

The Chagrin River Basin, shown in Figure 5, is located in the northeast of the basin area and drains an area of 267 square miles in Cuyahoga, Geauga, Lake, and Portage Counties. The main river



VICINITY MAP
SCALE OF MILES
50 0 50 100
LAKE HURON
LAKE ONTARIO
ONTARIO
NEW YORK
BUFFALO
DETROIT
LAKE ERIE
CLEVELAND
LORAIN
ROCKY RIVER BASIN
OHIO
PENN.
N
LAKE ERIE
LAKEWOOD
ROCKY RIVER
FAIRVIEW PARK
CLEVELAND
Parkview
North Olmsted
River Edge TWP
OLMSTED
Brook Park
ABRAM CR.
Parma Heights
PARMA
Olmsted Falls
Middleburg Heights
BEREA
BALDWIN CR
West View
BALDWIN LAKE
Columbia Station
WEST
BAKER CREEK
LORAIN COUNTY
CUYAHOGA COUNTY
Columbia Center
Columbia Hills Corner
Strongsville
EAST BRANCH
North Royalton
Broadview Heights
COLUMBIA
PLUM CREEK
Beebetown
MEDINA COUNTY
CUYAHOGA COUNTY
Bennetts Corners
HEALEY CR
Hardscrabble
LIVERPOOL
Brunswick
HINCKLEY
MEDINA COUNTY
SUMMIT COUNTY
RICHFIELD
Valley City
COSSETT CREEK
LAKE BRUNSWICK
Sherman Corners
Hinckley
Echo Lake Glen
HINCKLEY LAKE
KIRBY LAKE
SLEEPY HOLLOW LAKE
BRUNSWICK HILLS
GRAFTON
Osborn Corners
Erhart
Abbeyville
Remson Corners
LITCHFIELD
Lester
LESTER RESERVOIR
WEST BRANCH
Weymouth
NORTH BR
GRANGER
GRANGER DITCH
YORK
Mallet Creek
MALLET CR
MEDINA
Granger
Medina
LAFAYETTE
Windfall
MONTVILLE
SHARON
Poe
LEGEND
COUNTY LINE
TOWNSHIP LINE
VILLAGE LINE
WATERSHED LINE
U.S.G.S. RECORDING
SCALE OF MILES
0 1 2 3 4 5
ROCKY RIVER BASIN

FIGURE 4

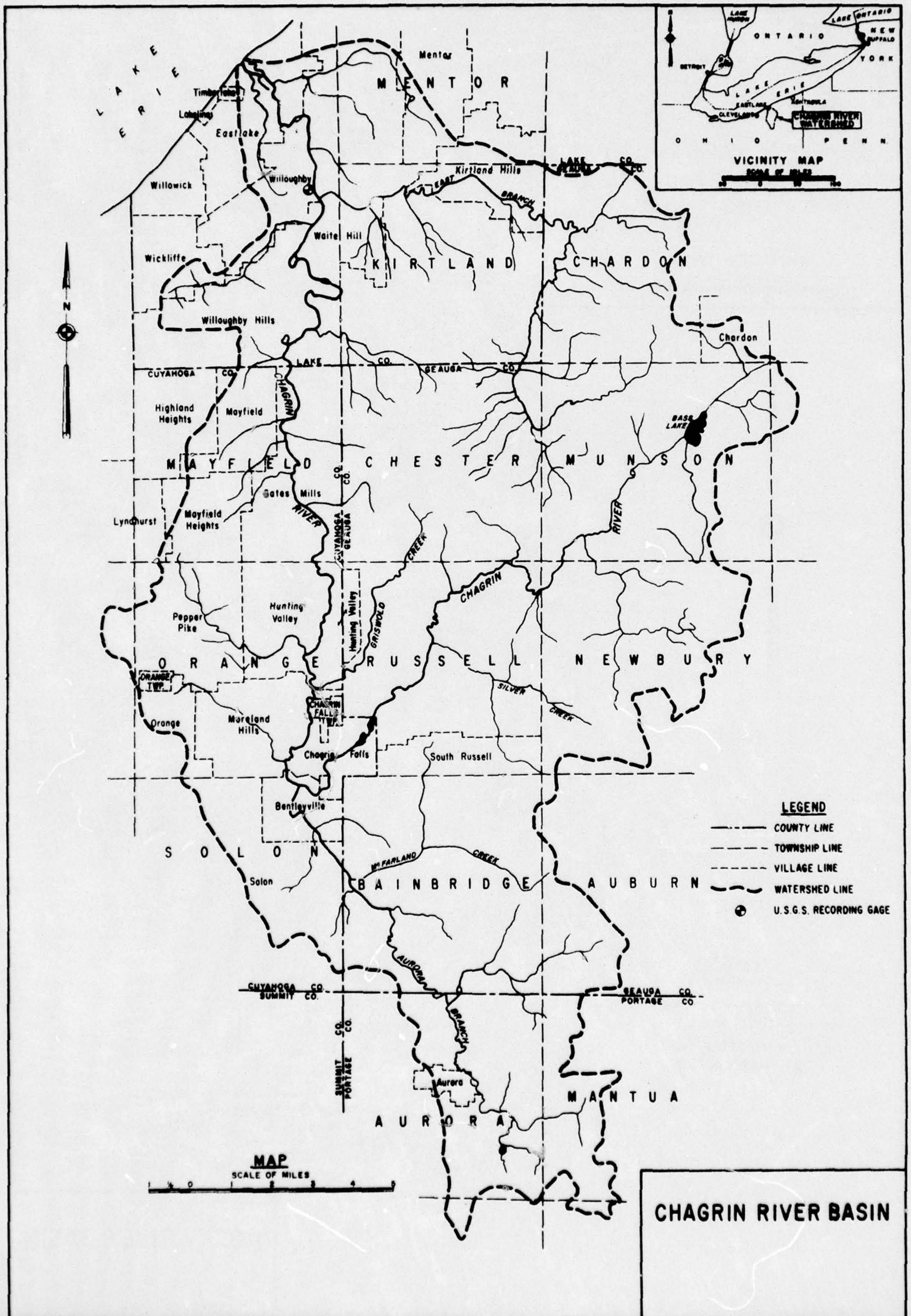
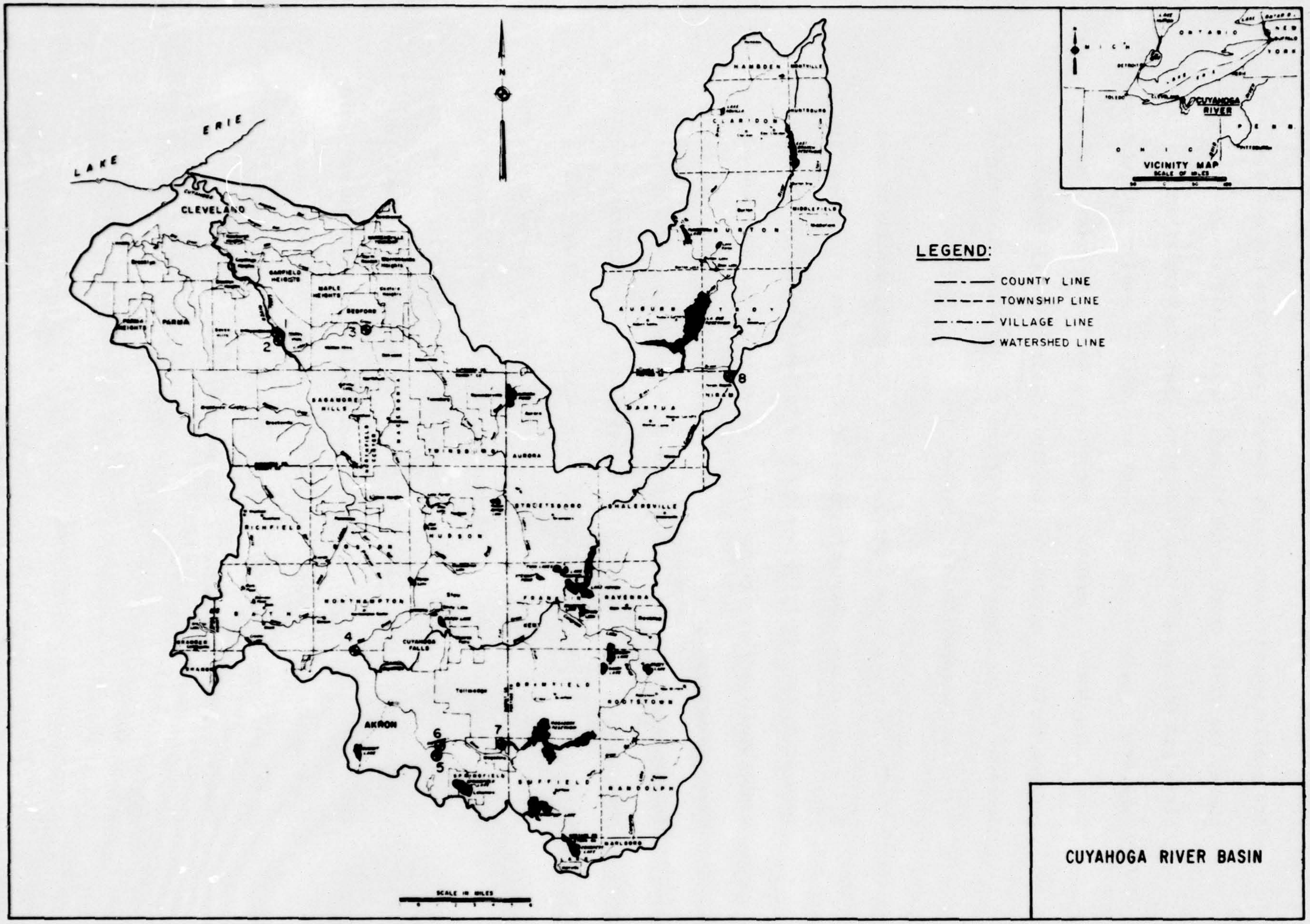

VICINITY MAP
LEGEND
COUNTY LINE
TOWNSHIP LINE
VILLAGE LINE
WATERSHED LINE
U.S.G.S. RECORDING GAGE
MAP
SCALE OF MILES
LAKE ERIE
MENTOR
KIRTLAND
CHARDON
MAYFIELD
CHESTER
MUNSON
ORANGE
RUSSELL
NEWBURY
SOLON
BAINBRIDGE
AUBURN
AURORA
MANTUA
Mentor
Eastlake
Willowick
Willoughby
Wickliffe
Waite Hill
Kirtland Hills
Willoughby Hills
Chardon
Highland Heights
Mayfield
Gates Mills
Lyndhurst
Mayfield Heights
Pepper Pike
Hunting Valley
Orange
Moreland Hills
Chagrin Falls
South Russell
Bentleyville
Solon
Aurora
CHAGRIN RIVER BASIN

FIGURE 5

rises south of the Village of Chardon and flows southwesterly to its confluence with the Aurora Branch coming from the south. From there, the river flows north through the easterly suburbs of Cleveland joining the East Branch and then discharging into Lake Erie. Much of the upland watershed is generally rolling wooded land. The lower 25 miles of the channel is deeply entrenched on bedrock until it emerges on the flood plain below Willoughby. Sections of the lower east branch and the main stem flow through the Cleveland Metropolitan Park System.

The Cuyahoga River Basin, shown in Figure 6, drains an area of 813 square miles. Beginning east of Chardon, only 16 miles from Lake Erie, the river flows southerly to Lake Rockwell. This impoundment, used for Akron water supply, severely limits the flow of the river downstream to the point at which Akron's treated wastewater is returned to the river. In extremely dry weather, the river in that stretch may consist only of leakages and the drainage from tributaries. Authority for the total use of the river by Akron was granted by the Ohio legislature in 1911. Below Lake Rockwell, the river flows southwesterly to Akron where it begins a northerly course through the greater Cleveland area to Lake Erie. Principal tributaries and the areas they drain include the Little Cuyahoga River (68.9 sq. mi.), Breakneck Creek (79.0 sq. mi.), Tinkers Creek (96.4 sq. mi.), and Big Creek (38.6 sq. mi.). The lower six miles of the Cuyahoga constitute a navigation channel with special problems that are inherent in its use and maintenance.



CUYAHOGA RIVER BASIN

FIGURE 6

In addition to the major rivers, there are several smaller stream basins directly tributary to Lake Erie. The combined drainage area of these minor creeks is approximately 133 square miles.

4. Topography.

The area of northern Ohio with which this report deals lies within the Appalachian Plateau physiographic province of the Appalachian Highlands and the Central Lowland physiographic province of the Interior Plains. The Appalachian Plateau, comprising the eastern half of Ohio, slopes to the west, is deeply cut by winding stream valleys, and has considerable local relief and steep hillsides. The northern portion of this plateau has had glacial action in the past, has rolling hills and valleys, and has somewhat more fertile soils than the unglaciated southern portion of the plateau. The Three Rivers Watershed slopes toward Lake Erie. The Central Lowlands, comprising the western half of Ohio, slope to the west and are made up mainly of plains interrupted by low morainal ridges. This area is covered by surficial deposits from past glaciation and has fertile soils.

In the Three Rivers Watershed area, the topography of the upland areas of the river basins generally consists of rolling hills. The area is largely wooded and contains numerous small lakes and swamps. In some areas, streams are of moderate slope and meander through broad valleys. As the rivers pass highly industrialized areas, they are often contained within artificial banks. The rivers in the upland areas often follow complex systems of buried valleys formed

during glacial melting. For the most part, soils formed on this glacial material have silt and clay loam textures with slow internal drainage. The coarser sand and gravels of flood plains and glacial outwash occur locally.

A relatively distinct escarpment divides the basin between an upland plateau and the lake plain. In the plain, the main streams are deeply entrenched and steep, and the valley floors are narrow. The lower courses of the Rocky and Chagrin Rivers are in deep-sided narrow valleys while the lower course of the Cuyahoga is flat-floored and wider. Pleistocene lakes once occupied these lower areas, and the silt laid down in these lakes is exposed at many places along the valley walls. Erosion of these silt deposits contributes in large measure to the sediment load of the rivers.

5. Geology.

The bedrock of the eastern half of Ohio is composed predominantly of old-aged sandstone, which is very resistant to erosion. The bedrock of the western half of Ohio is composed predominantly of old-aged limestone that is easily eroded. Preglacial erosion over millions of years made the limestone area into a plain and left the more resistant sandstone as hills. Glaciers covered the bedrock formations in the western and northeastern portion of Ohio in relatively recent geological time, modifying the terrain and depositing a mantle of

glacial drift over the land as they receded. Soils derived from the limestone glacial drift tend to be fertile for agricultural use while the soils weathered directly from sandstone bedrock in southeastern Ohio tend to be less fertile.

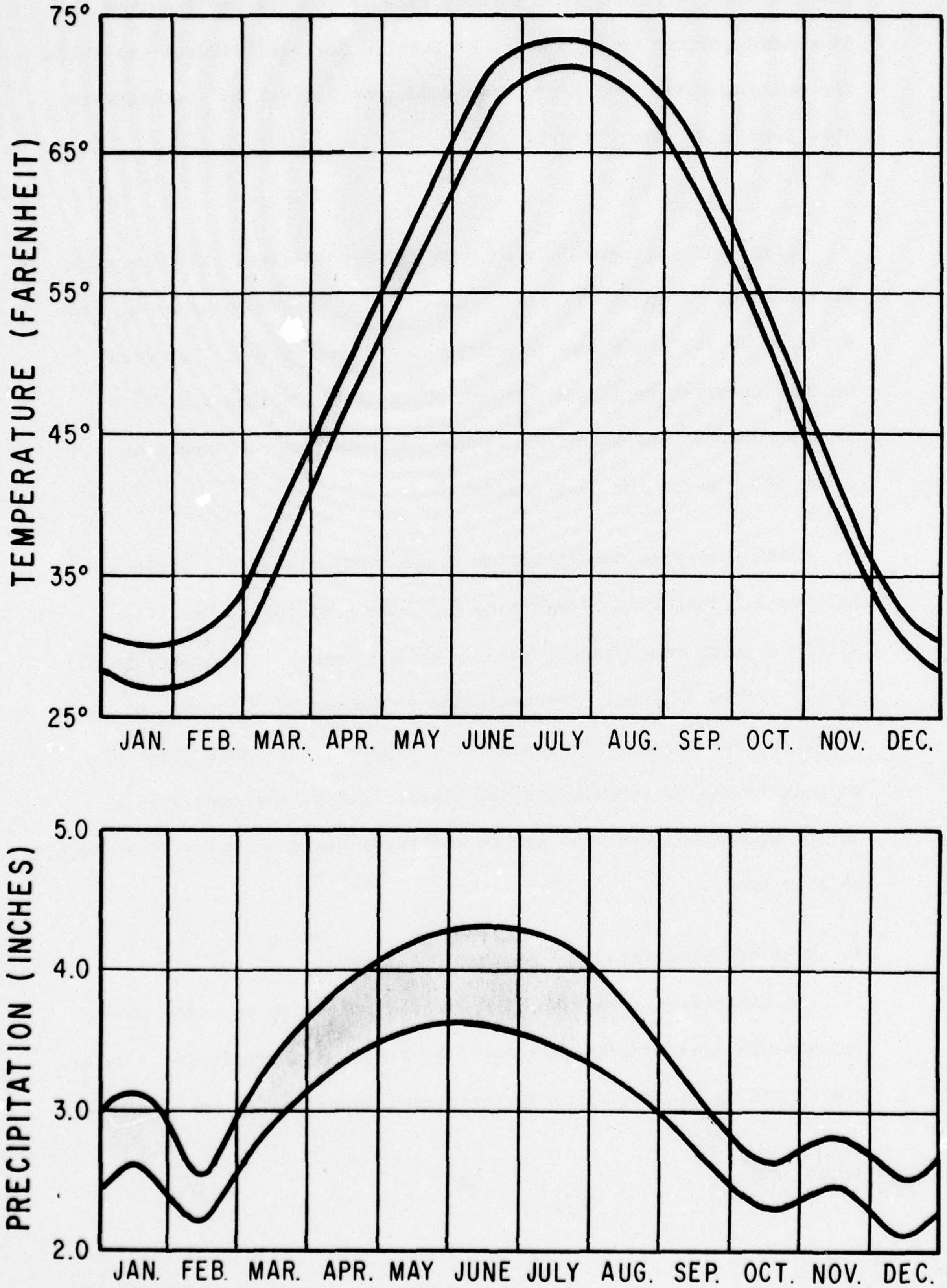
6. Climate.

Climate in northern Ohio follows Midwest seasonal patterns with the local modifying influence of Lake Erie. The three areas of Ohio affected by the study have similar climatic variation. The mean monthly temperature ranges between 26° F in the winter and 74° F in the summer. The long term trends indicate that temperatures above 32° F occur for nine months.

Monthly average precipitation trends show a seasonal variation between 2.1 inches in December to 4.3 inches in June. Variations within a given month range from 2.2 to 2.5 inches in February to 3.5 to 4.3 inches in June. Precipitation in excess of 3 inches can be expected from March until September. Figure 7 shows the range of monthly values of temperature and precipitation, averaged over a number of weather stations within the three areas of major consideration in this study.

B. Role of Water Resources in Area Development

The historical evolution of Cleveland and Akron as major urban centers has been largely influenced by their water resources. Water supply and water transportation were most important in the growth of



CLIMATIC TRENDS OF STUDY AREA

FIGURE 7

the area. The opening of the Erie Canal in 1825 connected Cleveland and all the Lake towns with the interior of the State of New York and New York City. Two years later, the completion of the Ohio Canal between Cleveland and the Ohio River linked Cleveland and Akron with the interior of the State of Ohio.

In the second half of the nineteenth century, Cleveland, being a water transportation center, became also an important urban center in the Industrial Revolution. The iron ore of the Marquette range in upper Michigan and the coal of southern Ohio were brought to the city for smelting.

After Cleveland's emergence as a major railroad transportation center in the 1850's, the confluence of Pennsylvania coal and Lake Superior iron ores accelerated her growth to a major industrial complex.

Presently, Cleveland is the largest overseas general cargo port on Lake Erie and the third largest on the entire Great Lakes.

C. <u>Demography and Land Use</u>

The 1970 census reported a population of 2,440,161 in the Three Rivers Watershed Area; 62 percent of that population was located in Cuyahoga County and another 20 percent was located in Summit County. The cities of Cleveland and Akron housed 750,903 and 275,425, respectively. More than 90 percent of the population is presently served by sanitary sewage systems.

Recent years have witnessed a gradual but significant change in the distribution of population within the area. Like most older, heavily industrialized cities in northeastern Ohio, Cleveland and Akron have been losing population to their surrounding suburbs, at rates of 14.3 and 5.1 percent, respectively, in the last decade.

The net out-migration of population from the central cities is reflected in the absorption of rural land by urban uses at a rate substantially exceeding the rate of population growth. The result is a general lowering of population density in the inner cities. At the same time, current suburban development is occurring at substantially lower densities than those of earlier suburban developments.

The area's urbanization takes the form of a multi-centered urban network. The principal centers are downtown Cleveland, located on the shore of Lake Erie, and Akron, located on the divide at the southern edge of the Cuyahoga basin. Although both of the centers have been declining in population and somewhat in influence in recent decades, they still constitute the principal cultural and economic centers within the region.

Rural land uses consist principally of general farming and dairying. In some areas these activities are supplemented by specialized production that includes fruit and vegetables. The extent of agricultural land use has been declining with rapid urbanization of the countryside.

D. Economic Activity

The indices of economic activity for the Three Rivers Watershed Area compare in mixed fashion with those of the State of Ohio and the Nation. For example, in 1970 the per capita effective buying income in the area ranged from $2,927 in Medina County to $4,058 in Cuyahoga County. The average for the area of $3,816 compared favorably with the State average of $3,355 and the National average of $3,308. On the other hand, the increases in income from 1966 to 1970 ranged from 22 percent in Medina County to 32 percent in Cuyahoga County, compared to the State average of 29.7 percent and the National average of 30.1 percent.

In 1970, the manufacturing sector employed approximately 385,000 persons in the Three Rivers Watershed Area, nearly 38 percent of the area's work force. Of that fraction, production of durable goods, specifically primary metal products, fabricated metal products, machinery and transportation equipment, maintained the bulk of the employment at 69 percent, increasing from 66 percent in 1960. The increase during the decade, however, masks the significant changes within the durable goods industries. Substantial decreases occurred in metal industries and transportation equipment, while employment nearly doubled for the other durable goods industries. This trend indicates a more diversified durable goods manufacturing mix within the Three Rivers Watershed Area.

The most notable exception to the dominance of durable goods manufacture was Summit County. In 1970, over 46 percent of the county's manufacturing work force were in rubber and plastic products. Rubber and plastic products manufacture also constituted the major employer in Portage County, employing 29 percent of the manufacturing work force.

During the last decade, Cuyahoga County has experienced the sharpest overall decline in employment in the manufacturing sector, with a drop from 38.7 percent in 1960 to 33.8 percent in 1970. This appears to reflect the trend of industrial decentralization away from Cuyahoga County's dense population concentration in the Cleveland area.

Agriculture employed an insignificant 0.9 percent of the labor force in the Three Rivers Watershed in 1970.

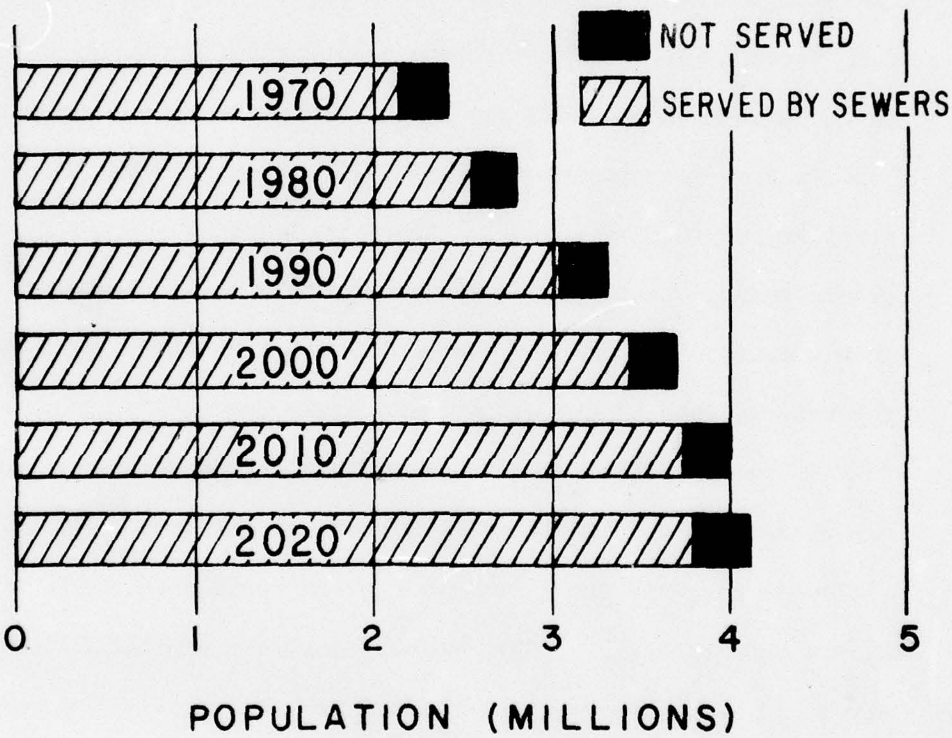
E. Patterns of Future Growth

1. Demography and Land Use.

Growth patterns established in the Three Rivers Watershed area during the last decade are expected to continue through the foreseeable future. The total population is expected to increase but the distribution will favor suburban growth at the expense of central cities. In addition to the predicted growth, the trend of redistribution from the central cities to the suburbs is also expected to be felt, particularly in Medina County to the west and Lake and Geauga Counties to the east.

Population projections for all or portions of the Three Rivers Watershed Area have been made by several agencies. These include the Great Lakes Basin Commission data, generated by the Office of Business and Economic Research, the Northeast Ohio Water Development Plan data, generated by The Ohio Department of Natural Resources, the Tri-County Planning Commission data, and the Cuyahoga County Regional Planning Commission data. The projections used for the Northeast Ohio Water Development Plan provided the basic growth rates for this study. The base figures were adjusted to the 1970 census data and then growth was projected to 2020 by decades. These projections provide for a larger growth than do those by the Cleveland Regional or Tri-County Planning Commissions. They are for the most part, slightly higher than the projections used by the Great Lakes Basin Commission, at least through 2010. Therefore, by using these projections to determine municipal waste loads, the facilities are adequately designed for future conditions. Figure 8 displays the forecasts for the total population of the Three Rivers Watershed area. The proportion of the population served by sewers is shown by the cross-hatched sections, while the proportion served by private systems such as septic tanks and tile fields is shown by the solid sections.

Well-established future trends in population growth or distribution that vary from those used must be recognized during the implementation of any wastewater management system, and facility designs must be modified accordingly.



PROJECTED POPULATION IN THREE RIVERS WATERSHED AREA

FIGURE 8

The history of land use planning in Northeast Ohio has not been one of widespread success. Land use and zoning policies are often modified to accommodate development with little long-term consideration. Until land use planning is made more effective, it is subject to continuous change. Therefore, the composite map in Figure 9 is only conceptual. Figure 9 categorizes only industrial-commercial, residential, agricultural, open space, and low density residential land uses.

The conceptual plan shown is applicable to both 1990 and 2020, with the major difference being in the population densities. The residential areas will probably approach the upper limit of the density range in the early 21st century.

2. Economic Activity.

As noted in Section D of this chapter, the average buying income for the Three Rivers Watershed area is higher than the State and National average. At the same time, the percentage increase from 1966 to 1970 is lower than the corresponding State and National increases. Therefore, it can be expected that in the future the regional buying income will increase more slowly than the State and National values until the latter two have caught up to the former. From projections in the Great Lakes Basin Framework Study, this can be expected to occur about 2000. After this time the growth in buying income in the region should be equal to that for the Nation.

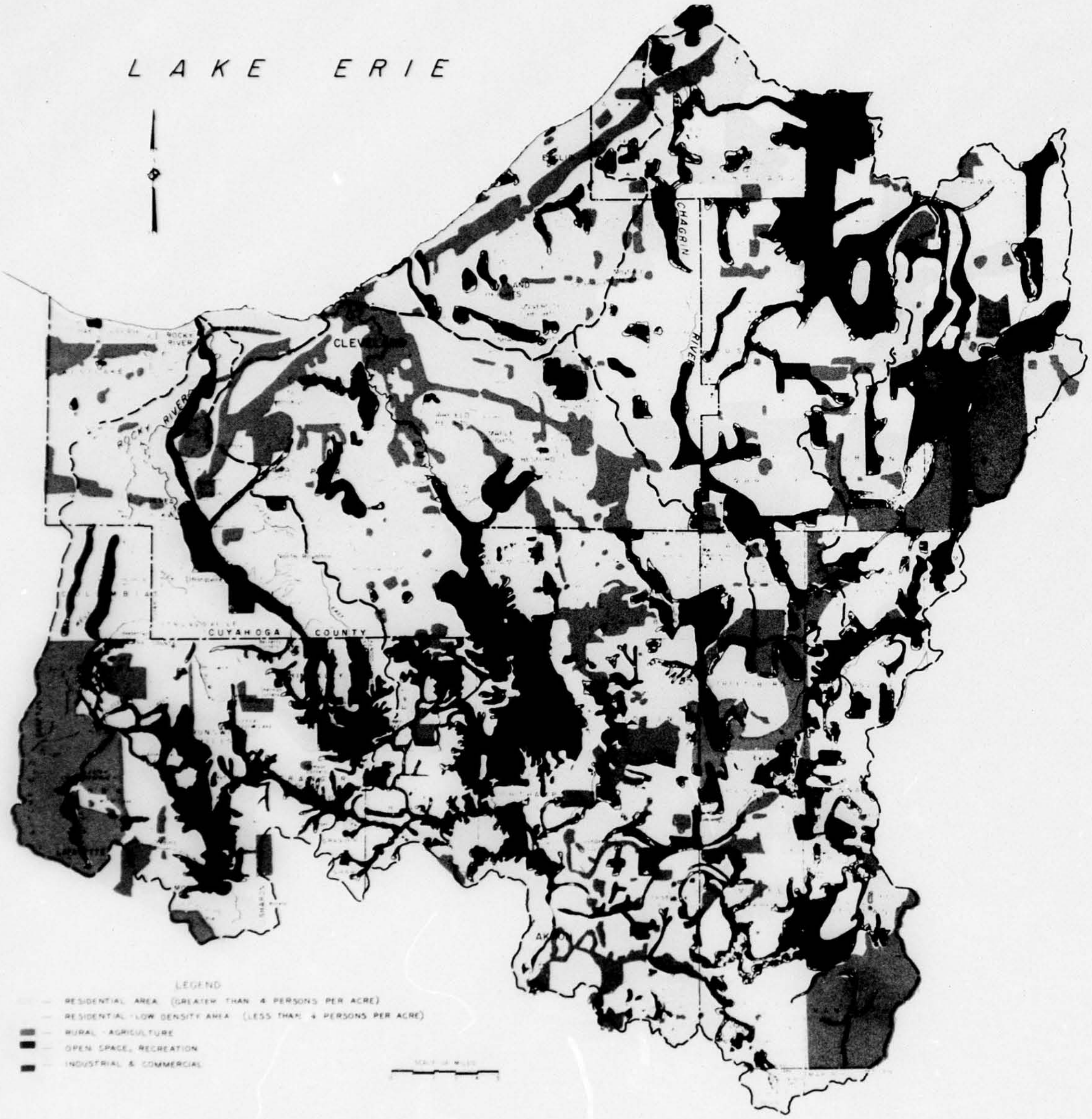


FIGURE 9
SURVEY SCOPE STUDY
WASTE WATER MANAGEMENT PROGRAM
CLEVELAND-AKRON METROPOLITAN
AND
THREE RIVERS WATERSHED AREAS
U.S. ARMY ENGINEER DISTRICT, BUFFALO
LAND USE

The overall annual employment rate for the area is expected to grow at about 0.7 percent over the next 50 years. For the manufacturing sector, however, the growth rate is only projected at about 0.3 percent per year. Based on this rate, the manufacturing sector employment will increase from 385,000 in 1970 to about 432,000 by 2020. Within this sector, durable goods employment is projected to decrease from 69 percent to 56 percent by 2020. The trends also indicate that within this downward trend in durable goods, the metal industries and transportation equipment section will bear the bulk of the losses.

The percentage of the work force in Summit and Portage Counties employed in the rubber and plastic products industry is expected to increase only slightly. For Summit County, employment in these industries will grow from 46 percent to 48 percent, while in Portage County the growth will be from 29 percent to 30 percent, both by 2020.

The trend of decentralization of manufacturing industries away from Cuyahoga County is expected to continue through 2020. However, the rate of decrease should be much slower in the future because of offsetting increases in certain portions of this sector.

CHAPTER 4

WATER SUPPLY AND WATER QUALITY NEEDS AND PROBLEMS

A. Introduction

There are several water resource needs and problems in the Three Rivers Watershed area. In addition to water supply and water quality, this list includes flood management (including both flood plain management and flood control measures), navigation, and recreation. The Northeast Ohio Water Development Plan addresses a wide range of these needs, not only for the Three Rivers Watershed, but for the rest of northeast Ohio as well.

As noted in Chapter 1, the scope of this study is focused primarily on water quality, water reuse, and constituent recycling. Wastewater management systems will, however, have an impact on the other water resource needs in the area. This study did not view these other needs as primary objectives. Rather, the impacts of the alternative wastewater systems on these needs and problems were assessed and measured, where possible, if these impacts appeared to be critical to the decision-making process. Therefore, the discussion of water resource needs and problems in this chapter is directed to the vital issues of water supply and water quality.

B. Supply and Demand, Present and Future

Adequate water has been and will continue to be one of the major elements governing residential and industrial development throughout

northern Ohio. At the present rate of urbanization and industrialization, both the quantity and quality of water are important. Lake Erie, together with the principal rivers, reservoirs, and inland lakes, assures a vast supply of surface water to most localities of the region. Lake Erie, for example, supplies a total of some 23 municipal water systems in the United States. About 2.7 billion gallons per day are withdrawn from the Lake for residential, commercial and industrial uses. In 1969, the City of Cleveland delivered 132 billion gallons of water to the more than two million population served by its system.

In spite of the abundance of water available from Lake Erie, some upstream communities have elected to develop water supplies from tributary headwaters. Many of those communities must develop additional supplies in the near future in order to meet demands. For example, the Northeast Ohio Water Development Plan includes the development by 1980 of a well field near Burton to increase the water supply to Akron by 44 million gallons per day (MGD), and the construction of a reservoir on the West Branch of the Cuyahoga River to increase supply to Geauga County by almost 16 MGD.

Akron is expected to need additional supplies of 40 MGD by the year 2000. This supply could be provided by an additional reservoir on the Cuyahoga River near Burton, by development of a well field, or by recycling high quality wastewater. There is a potential use conflict because the reservoir option would affect a section of the National Scenic River system on the upper Cuyahoga. The alternative sources of

supply need to be fully examined prior to a final decision.

Other upstream communities may meet their future needs by improving existing well fields.

In 1970, industries in the Three Rivers Watershed Area used approximately 250 billion gallons of water; this is an average of 682 MGD. More than 75 percent of that usage was for cooling purposes, with the remainder for processing.

Future industrial water use will depend upon technological changes and water conservation and recycle practices by the industry. If current nominal reuse practices are continued by the industries, water use in the Three Rivers Watershed Area will increase to 925 MGD by 2020, still with 75 percent for cooling and 25 percent for processing. Conversely, if water conservation and reuse practices are maximized, water use can be reduced to 335 MGD by 2020, proportioned at 57 percent for cooling and 43 percent for processing.

C. Pollution Loads, Present and Future

The present per capita flow of municipal wastewater for separate and combined systems are found to be 110 and 156 gallons per day, respectively, for the Three Rivers Watershed. These values are based upon 1970 population data and on 1970 wastewater treatment plant records. Industrial flows have been deducted from the total plant flow in computing these numbers.

Projections of future municipal waste flows considered such factors as:

1. The present trend of increase in water consumption, per capita.

2. Potential increased use of water saving devices for the home.

3. The possible development of water reuse systems for the home.

4. Reduction in infiltration rates due to improved sewer construction techniques.

5. Replacement of certain existing combined sewers with separate sewers.

The resulting municipal wastewater flow projections are shown in Table 3.

TABLE 3

MUNICIPAL WASTEWATER FLOWS
(gpcd - gallons per capita per day)

	1970	1980	1990	2000	2010	2020
Separate systems	110	120	125	130	140	150
Combined systems	156	160	164	168	172	175

Present and projected pollution loads for municipal wastewater treatment plants have also been estimated. Per capita contributions are projected to increase for only Biochemical Oxygen Demand (BOD) and suspended solids. This is principally because of the impact of an increasing number of garbage disposals. Projections of municipal pollution loads are displayed in Table 4.

TABLE 4

MUNICIPAL WASTEWATER POLLUTION LOADS
(pounds per capita per day)

	1970	1980	1990	2000	2010	2020
Biochemical Oxygen Demand (BOD)						
Separate Systems	.17	.18	.185	.19	.19	.195
Combined Systems	.15	.15	.16	.16	.17	.17
Suspended Solids						
Separate Systems	.18	.185	.19	.195	.195	.20
Combined Systems	.23	.23	.24	.24	.25	.25
Organic Nitrogen	.0146	.0146	.0146	.0146	.0146	.0146
Ammonia Nitrogen	.0097	.0097	.0097	.0097	.0097	.0097
Total Phosphorus as P	.0116	.0116	.0116	.0116	.0116	.0116
Sulfate	.0367	.0367	.0367	.0367	.0367	.0367
Chloride	.046	.046	.046	.046	.046	.046

Present and future industrial wastewater flows are summarized in Table 5, and industrial pollution loads are summarized in Table 6. Future industrial waste loads will be influenced both by industrial growth and by changing water use practices in industry. The wastewater flows will reflect water use, influenced by water conservation and recycle practices. Mass pollution loads, however, are principally influenced by industrial growth and technological changes.

TABLE 5

INDUSTRIAL WASTEWATER FLOWS (MILLION GALLONS PER DAY)

	ASSUMING NOMINAL RECYCLE				ASSUMING MAXIMUM RECYCLE			
	Discharge to Municipal Sewerage System		Direct Discharge to Waterway		Discharge to Municipal Sewerage System		Direct Discharge to Waterway	
Year	Process	Cooling	Process	Cooling	Process	Cooling	Process	Cooling
1970	62	39	101	481				
1990	67	46	129	534	36	15	79	162
2020	83	57	160	626	44	18	99	173

TABLE 6

INDUSTRIAL WASTE LOADS (POUNDS PER DAY)

	Biochemical Oxygen Demand (BOD)	Chemical Oxygen Demand (COD)	Suspended Solids	Total Dissolved Solids	Oil	Total Kjehdahl Nitrogen	Phosphorous	Sulfate	Chloride	Fluoride	Cyanide	Phenol	Silver	Copper	Chromium	Cadmium	Nickel	Lead	Zinc	Iron	Tin	Aluminum	Manganese
1970	305,700	921,300	2,360,000	825,000	129,200	17,800	4,400	25,700	92,400	780	2,600	460	20	2,300	2,800	490	1,900	340	5,100	379,400	41	81	69
1990	327,500	957,400	2,746,700	913,600	151,100	19,900	4,900	30,000	109,000	920	3,200	540	25	2,900	3,500	580	2,300	400	5,800	447,800	49	97	82
2020	367,800	1,078,900	3,120,800	1,069,700	173,600	22,400	5,300	34,200	123,800	1,040	3,900	620	30	3,500	4,300	670	2,800	450	6,700	508,700	57	119	96

Urban stormwater runoff contributes significant pollution loads to Lake Erie and its tributaries. Table 7 lists the pollution concentrations from separate system urban stormwater runoff. These concentrations vary as does the percent imperviousness, a measure of the degree of urbanization. The concentration of phosphorous and nitrogen tends to be less in dense urban areas because of a lesser amount of lawn and green space. Table 8 lists the pollution concentrations of combined sewer overflows.

TABLE 7

SEPARATE SYSTEM STORMWATER RUNOFF CHARACTERISTICS

	Rural	Urban	Dense Urban
Imperviousness	5%	25%	55%
Suspended Solids	200 mg/1*	300 mg/1	500 mg/1
BOD	3 mg/1	20 mg/1	30 mg/1
COD	50 mg/1	150 mg/1	200 mg/1
Total Volatile Solids	35 mg/1	110 mg/1	140 mg/1
Suspended Volatile Solids	25 mg/1	80 mg/1	105 mg/1
Phosphorus as P	.2 mg/1	.7 mg/1	.5 mg/1
Nitrogen as N	2.0 mg/1	3.1 mg/1	2.2 mg/1
Chlorides	60 mg/1	160 mg/1	166 mg/1

TABLE 8

COMBINED SEWER OVERFLOW CHARACTERISTICS

Suspended Solids	200 mg/1*
BOD	60 mg/1
COD	220 mg/1
Total Volatile Solids	160 mg/1
Suspended Volatile Solids	120 mg/1
Phosphorus as P	8 mg/1
Nitrogen as N	12 mg/1
Chlorides	161 mg/1

* mg/1 = milligrams per liter

The stormwater runoff pollution loads from a rural area are low compared to those from an urban area of equal size. However, rural land currently represents three times the area of urban land. By 2020, urban land areas will exceed rural land areas. The first column of Table 7 shows the concentrations of the waste constituents from rural stormwater runoff.

Table 9 summarizes the flows and pollution loads contributed by the four major sources. The display demonstrates the decrease in relative and absolute contribution of pollutants from rural stormwater runoff, resulting principally from the urbanization of rural lands. For that reason, structural measures for the control of rural stormwater runoff pollution are not included in the designs and costs included in this report. In addition, the rural contribution will also decrease as better methods of plowing, applying fertilizer, and other farming activities are developed. The tabulated amounts, then, probably represent a high estimate for future pollution loads.

TABLE 9

WASTE LOADS GENERATED WITHIN THE STUDY AREA

	1970	1990		2020	
AREA (ACRES)					
Urban	225,000	416,200		499,100	
Rural	739,400	548,200		465,300	
TOTAL	964,400	964,400		964,400	
FLOW (MGD)					
Domestic	313	463		628	
Industrial		*MIN	**MAX	*MIN	**MAX
Process	163	115	197	143	243
Cooling	520	177	579	191	682
Urban Runoff	97	171		224	
Rural Runoff	216	160		136	
BIOCHEMICAL OXYGEN DEMAND (LB/DAY)					
Domestic	335,290	519,180		685,250	
Industrial	305,760	327,510		367,870	
Urban Runoff	26,190	37,130		52,530	
Rural Runoff	5,840	4,330		3,670	
TOTAL	673,080	888,150		1,109,320	
SUSPENDED SOLIDS (LB/DAY)					
Domestic	470,920	672,830		846,610	
Industrial	2,360,040	2,747,010		3,121,130	
Urban Runoff	199,420	382,940		577,370	
Rural Runoff	368,610	273,290		232,020	
TOTAL	3,398,990	4,076,070		4,777,130	
PHOSPHOROUS (AS P) (LB/DAY)					
Domestic	25,100	35,700		43,370	
Industrial	4,380	4,930		5,260	
Urban Runoff	2,880	3,400		3,950	
Rural Runoff	360	270		220	
TOTAL	32,720	44,300		52,800	
NITROGEN (AS N) (LB/DAY)					
Domestic	52,580	74,800		92,480	
Industrial	17,840	19,870		22,440	
Urban Runoff	5,230	7,150		8,910	
Rural Runoff	3,590	2,660		2,270	
TOTAL	79,240	104,480		126,100	
CHLORIDES (LB/DAY)					
Domestic	71,730	110,420		141,710	
Industrial	92,420	109,050		123,850	
Urban Runoff	111,160	194,270		295,400	
Rural Runoff	107,900	80,010		67,900	
TOTAL	383,210	493,750		628,860	

* Projecting Maximum Reuse

** Projecting Nominal Reuse

D. Water Quality

1. Rocky River.

Numerous reaches of the Rocky River, on both the East and West Branches, are polluted by poorly treated and untreated domestic wastes. Only a few miles of the headwater regions are relatively unpolluted. Extensive organic sludge deposits exist below water treatment plants and wastewater treatment facilities. According to 1970 data, coliform bacteria exceed the existing State of Ohio Stream Quality Standards in nearly all areas. Dissolved oxygen levels decline to near zero in downstream regions during summer low flow periods. Total dissolved solids exceed existing Ohio standards in most cases.

The aquatic life in most regions contains, and in some is dominated by, pollution-tolerant animals such as sludge worms and chironomid larvae. These organisms usually account for more than 60 percent of the bottom-dwelling (benthic) animals. The variety of aquatic organisms is very low, except for short sections of the headwaters region.

2. Chagrin River.

Most sections of the Chagrin River contain water of relatively good quality. Short stretches below several wastewater treatment facilities contain sludge deposits and relatively low levels of dissolved oxygen. Mildly toxic materials enter the stream in one short stretch at Chagrin Falls. Coliform bacteria usually exceed the existing State of Ohio Stream Water Quality Standards in most areas.

Benthic aquatic life in the Chagrin is dominated by pollution-sensitive or intermediately sensitive organisms. These organisms usually account for over 80 percent of the benthic community. Cold water fish including trout and darters inhabit several headwater areas. The variety of organisms is moderate to large in most regions.

3. Cuyahoga River.

Water quality in the Cuyahoga River above Lake Rockwell is relatively good. Except for small areas of decaying vegetation and excessive floating debris, this section of the river meets existing Ohio Stream Water Quality Standards.

Between Lake Rockwell and Akron, the river is adversely affected by (1) withdrawal of water for the City of Akron, (2) waste leakage from the Akron water treatment plant, (3) effluents from small plating industries, (4) effluent from a municipal wastewater treatment facility, (5) heated effluent from a fossil fueled power plant, and (6) oil, salts, soil sediments, and debris from poorly managed urban and industrial construction projects. Within the City of Akron, in spite of significant progress in pollution control by the rubber industry, considerable quantities of toxic industrial wastes still enter the Cuyahoga River via the Little Cuyahoga River. Akron's municipal wastewater is discharged into the river after receiving secondary treatment. This effluent and the industrial waste discharges at and below the city, severely degrades the Cuyahoga River for 15 to 20 miles downstream. Between Lake Rockwell and Cleveland, nearly all of the existing Ohio Stream Water Quality Standards are violated, at least periodically. Within Cleveland, domestic and industrial wastewaters drastically alter

the normal physical and biological characteristics of the river.

The bottom-dwelling aquatic life in the upper Cuyahoga is dominated by organisms that can tolerate intermediate levels of pollution. These organisms usually account for over 60 percent of the benthic community. The lack of suitable habitat limits the distribution and abundance of organisms in the upper river that are sensitive to pollution. There is a moderate variety of aquatic life, including game fish and pollution-sensitive minnows and darters.

In the middle and lower sections of the river, the bottom-dwelling aquatic life is dominated by pollution-tolerant organisms. In most cases these organisms account for over 90 percent of the benthic community. Both the variety and abundance of life are severely limited. Several species of pollution-tolerant fish survive in a few areas, but many portions of the region are devoid of a permanent fish population.

The lower 11 miles of the Cuyahoga River, between the Cleveland Southerly treatment plant and the mouth has received landmark recognition. This portion of the river receives pollution loads of such magnitude that it has been classed as the third dirtiest river in the United States by the U. S. EPA.

This stretch is characterized by the absence of dissolved oxygen in summer low flow periods, floating oil and debris, industrial wastes including ammonia, phenols, cyanides, pickling liquors, acids, heavy metals, plating wastes, paint residue, and solvents, heat, solids, municipal sewage, and combined sewer overflows.

Tables 10, 11, and 12 summarize the current conditions of the Rocky, Chagrin, and Cuyahoga Rivers, respectively, relative to the existing Ohio Stream Quality Standards. These standards, described in Attachment B, are currently under study by the Ohio EPA for possible revision.

TABLE 10

BASELINE CONDITIONS IN THE ROCKY RIVER BASIN IN RELATION TO THE STATE OF OHIO WATER QUALITY STANDARDS.
CODE (-) UNACCEPTABLE, (+) ACCEPTABLE, (o) DATA NOT AVAILABLE

Waterway or section thereof	State of Ohio Water Quality Standards								All water must be free from			
STANDARDS	Coliform bacteria	Temperature	pH	Threshold-Odor No.	Radioactivity	Dissolved Oxygen	Dissolved Solids	Other Chemicals	Toxic substances	Putrescent sludge	Floating debris	Nuisance odor
1. Rocky River and all tributaries	-	+	+	o	o	-	-	-	-	-	-	-
2. West Branch upstream of Route 3 (approximately upstream of North Branch)	-	+	+	o	o	+	-	o	+	-	-	+
3. North Branch of the West Branch downstream of Bagdad Road (approximately lower 1.5 miles)	-	+	+	o	o	+	+	o	+	-	-	+
4. East Branch in the vicinity of Baldwin Lake	-	+	+	o	o	+	+	o	inconclusive			
5. Baldwin Creek in the vicinity of Coe Reservoir	-	+	+	o	o	+	+	o	inconclusive			
6. All lakes being used for swimming or water contact sports	*											

* Some areas require chlorination to meet bacterial standards.

TABLE 11

BASELINE CONDITIONS IN THE CHAGRIN RIVER BASIN IN RELATION
TO THE STATE OF OHIO WATER QUALITY STANDARDS
CODE (-) UNACCEPTABLE, (+) ACCEPTABLE, (o) DATA NOT AVAILABLE

Waterway or section thereof	State of Ohio Water Quality Standards								All water must be free from			
	Coliform bacteria	Temperature	pH	Threshold-Odor No.	Radioactivity	Dissolved Oxygen	Dissolved Solids	Other Chemicals	Toxic substances	Putrescent sludge	Floating debris	Nuisance odor
1. Chagrin River and all tributaries	-	+	+	o	o	+	+	o	+	-	-	-
2. East Branch at its mouth	-	+	+	o	o	+	+	o	+	-	-	+
3. Main stem in the vicinity of Daniels Park (5 miles upstream of the mouth)	-	+	+	o	o	+	+	o	+	+	-	+
4. Main stem upstream from Chagrin Falls	-	-	+	o	o	-	+	o	+	+	-	+
5. Aurora Branch	-	-	+	o	o	-	+	o	+	-	-	+
6. East Branch	-	-	+	o	o	+	+	o	+	+	-	+
7. All lakes being used for swimming or water contact sports	-	+	+	o	o	+	+	o	+	+	-	+

TABLE 12

BASELINE CONDITIONS IN THE CUYAHOGA RIVER BASIN IN RELATION TO THE STATE OF OHIO WATER QUALITY STANDARDS.
CODE (-) UNACCEPTABLE, (+) ACCEPTABLE, (o) DATA NOT AVAILABLE

Waterway or section thereof	State of Ohio Water Quality Standards								All water must be free from			
	Coliform bacteria	Temperature	pH	Threshold-Odor No.	Radioactivity	Dissolved Oxygen	Dissolved Solids	Other Chemicals	Toxic substances	Putrescent sludge	Floating debris	Nuisance odor
1. Cuyahoga upstream of Lake Rockwell and tributaries thereof	+	+	+	+	o	+	+	+	+	-	-	+
2. Lake Rockwell to State Route 17 (approx. from Lake Rockwell to Garfield Heights)	-	+*	+	o	o	-	-	-	-	-	-	-
3. State Route 17 to Coast Guard Station (Garfield Heights to Lake Erie	-	+	+	o	o	-	-	-	-	-	-	-
4. Little Cuyahoga River upstream of State Route 91 and downstream of Hazel Street (Upstream from a point 1 mile upstream of gaging station 6)(Downstream of a point 2 miles upstream of Ohio Canal)	-	+	+	o	o	-	-	-	-	-	-	-
5. Little Cuyahoga River between Route 91 and Hazel Street, Summit Lake and Ohio Canal	-	-	+	o	o	-	-	-	-	-	-	-
6. All other tributaries between Lake Rockwell and Harvard Avenue				inconclusive								
7. For the following lakes, ponds, or reservoirs: Aquilla, Brady, Congress, Geauga, Hudson, Springs, Mogadore, Muddy, Muzzy, Punderson, Sandy, Snow, Springfield, Silver, Wyoga, Aurora Pond				inconclusive								
8. All other small lakes now used for swimming and water contact sports				inconclusive								

* NOTE: Except for a short distance below a fossil leveled power plant

CHAPTER 5

PLAN FORMULATION AND EVALUATION PROCESS

A. Introduction

The process of plan formulation is the systematic development of plans to meet the basic goals and objectives as stated in Chapter 2. As alternative plans are developed, they are screened and subsequently evaluated and reformulated. Initially, evaluation provides information to be used in formulating and refining components of alternative wastewater systems. Also, it provides a mechanism for analyzing systems in the context of identifying and measuring all of their significant beneficial and detrimental effects.

B. Formulation Process

Alternative regional wastewater management plans were developed using a range of known technologies. Plans with pure technologies or combination technologies were formulated to achieve two levels of water quality. The formulation took into consideration current plans and also provided alternatives to these plans. The objective in doing this was to provide the State of Ohio with an initial set of alternatives that would display combinations of criteria, technologies, and economies of scale. From these, the State and the public assisted in the selection of plans for refinement during the third phase of planning.

Within this framework and in consideration of meeting the objectives established, an array of wastewater management alternatives were developed to determine the environmental, social, and economic advantages and disadvantages to compare the use of

various treatment technologies and the trade-off between the two levels of design criteria.

The twelve alternative plans making up the initial array are described in Chapter 6.

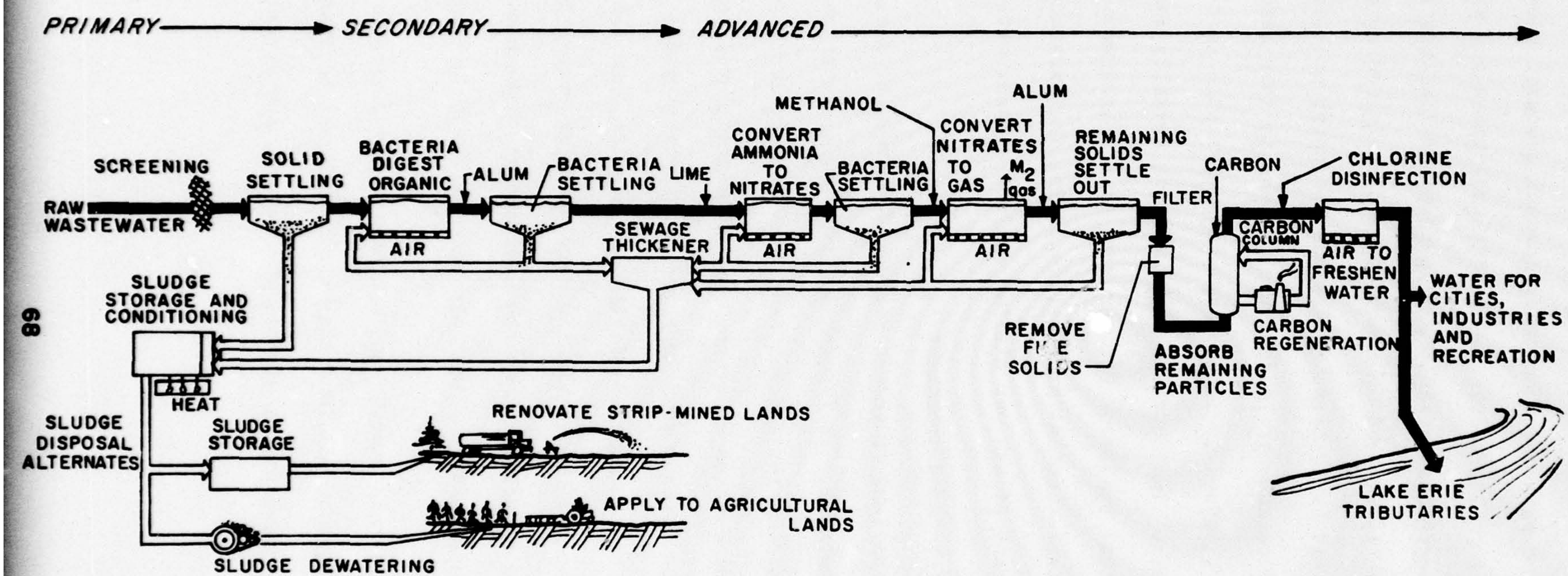
1. Wastewater Treatment Technologies.

The wastewater management alternatives for the highest levels of treatment were developed around three fundamental wastewater treatment technologies. They are advanced biological, physical-chemical, and land treatment.

(a) Advanced Biological Treatment

The advanced biological treatment process, shown schematically in Figure 10, provides an environment for the accelerated growth of bacteria that use the organic matter contained in wastewater as a source of food, converting it to carbon dioxide and water. Sufficient oxygen to complete the digestive process is artificially supplied. To remove nitrogen, additional bacteria are used to convert nitrogen into the gaseous form. Many industrial wastes are toxic to these bacterial communities and must be excluded from the wastewater.

Settling is required to separate solids and bacteria from the water. Phosphorus is removed by chemical reaction and settling, and filtration removes the fine particles. Approximately 1.1 tons of sludge are produced per million gallons of wastewater treated by the advanced biological process.



BIOLOGICAL TREATMENT

FIGURE 10

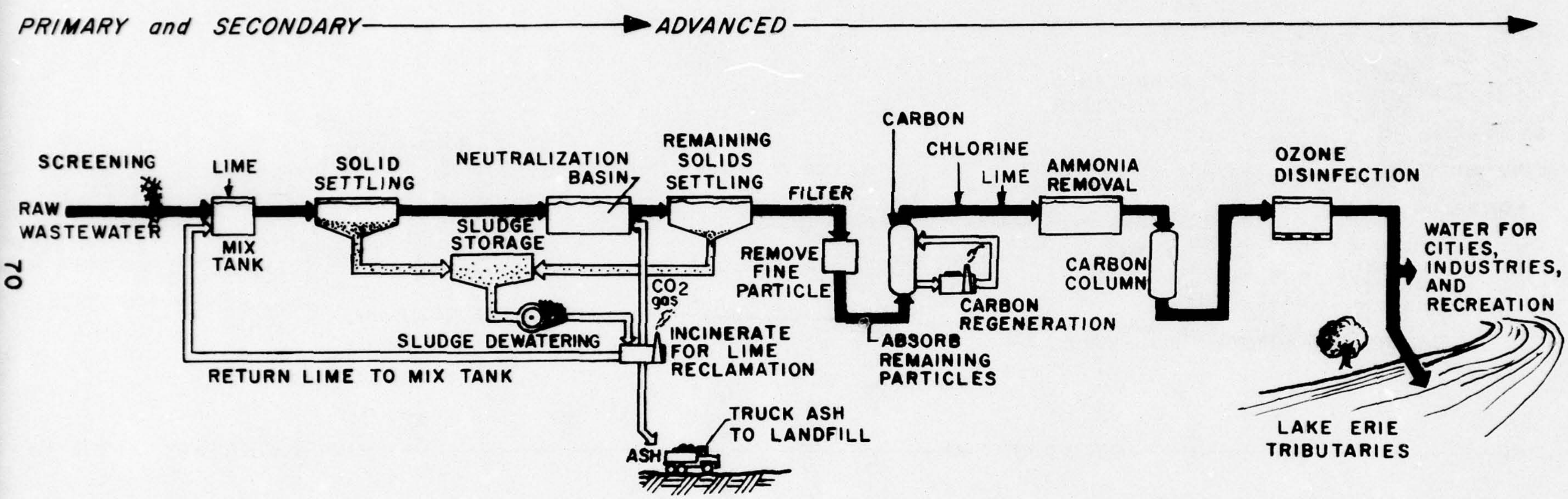
(b) Physical-Chemical Treatment

The physical-chemical treatment process, shown schematically in Figure 11, relies on chemical reactions and physical mechanisms to remove both organic and inorganic pollutants from wastewater. Organic matter is removed by adsorption to activated carbon, nitrogen is removed as a gas by chlorine oxidation, and phosphorus is removed by chemical reaction and settling. This process is less susceptible to reduced effectiveness by industrial wastewater than is the advanced biological process. Incineration of sludges is normally associated with physical-chemical treatment for recovery of the treatment chemicals. The physical-chemical process, including incineration, produces approximately 0.9 tons of ash per million gallons of wastewater.

(c) Land Treatment

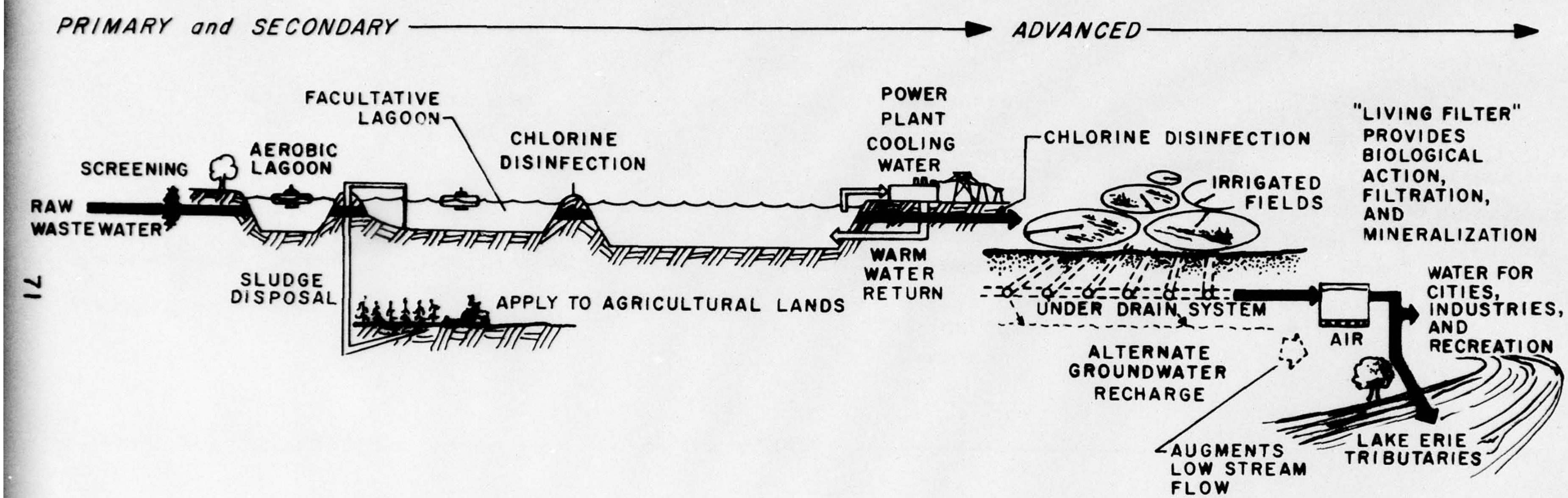
The land treatment method of wastewater purification, shown schematically in Figure 12, provides a direct pathway through which organic matter and nutrients can be recycled to the soil to enhance the production of crops. Land treatment utilizes the natural processes of the earth's soil zone and the growing crops, relying on the existing soil biota, the soil filtering capacity, and the chemical exchange ability of the soil to retain the nutrients for uptake by the crops. The effect is to recycle back to the environment those substances discarded as pollutants by man that are necessities to nature.

In this study, land application is always preceded by secondary level treatment in either a conventional activated sludge plant or in an aerated lagoon system. Therefore, industrial wastewaters toxic to



PHYSICAL-CHEMICAL TREATMENT

FIGURE 11



LAND TREATMENT

FIGURE 12

those biological processes must be excluded from the wastewater. Approximately 0.6 tons of sludge are produced for each million gallons of wastewater treated by the activated sludge process. The aerated lagoon produces approximately 0.2 tons of sludge for each million gallons of wastewater.

(d) Secondary Treatment

The technologies studied included activated sludge and aerated lagoons for secondary treatment. Advanced biological, physical-chemical, and application upon land were considered as final treatment alternatives. Any of the final treatment technologies could be used in conjunction with either of the secondary treatment technologies. The study effort considered that secondary treatment by either activated sludge or aerated lagoon technology could be used prior to land treatment. In no case was the land application technology used unless the effluent to be applied had, prior to its application on land, received secondary treatment by either of the management technologies discussed. Further, in all cases where effluent is applied to the land for final treatment, the treated water is collected by underground drain tiles and removed from the site.

As stated, any of the advanced wastewater treatment facilities may be used in conjunction with either the activated sludge plants or aerated lagoons. This is important because it allows the phasing of the land treatment components in such a manner that the existing activated sludge plants can continue to be operated for the remainder of their useful lives in conjunction with land treatment, after which they

might be replaced by aerated lagoons at the land treatment sites. By using existing activated sludge treatment plants, minimum expenditures are needed to achieve secondary treatment. Thus, more funds are available to phase the upgrading of the system to Level I by 1983 and Level II by 1985.

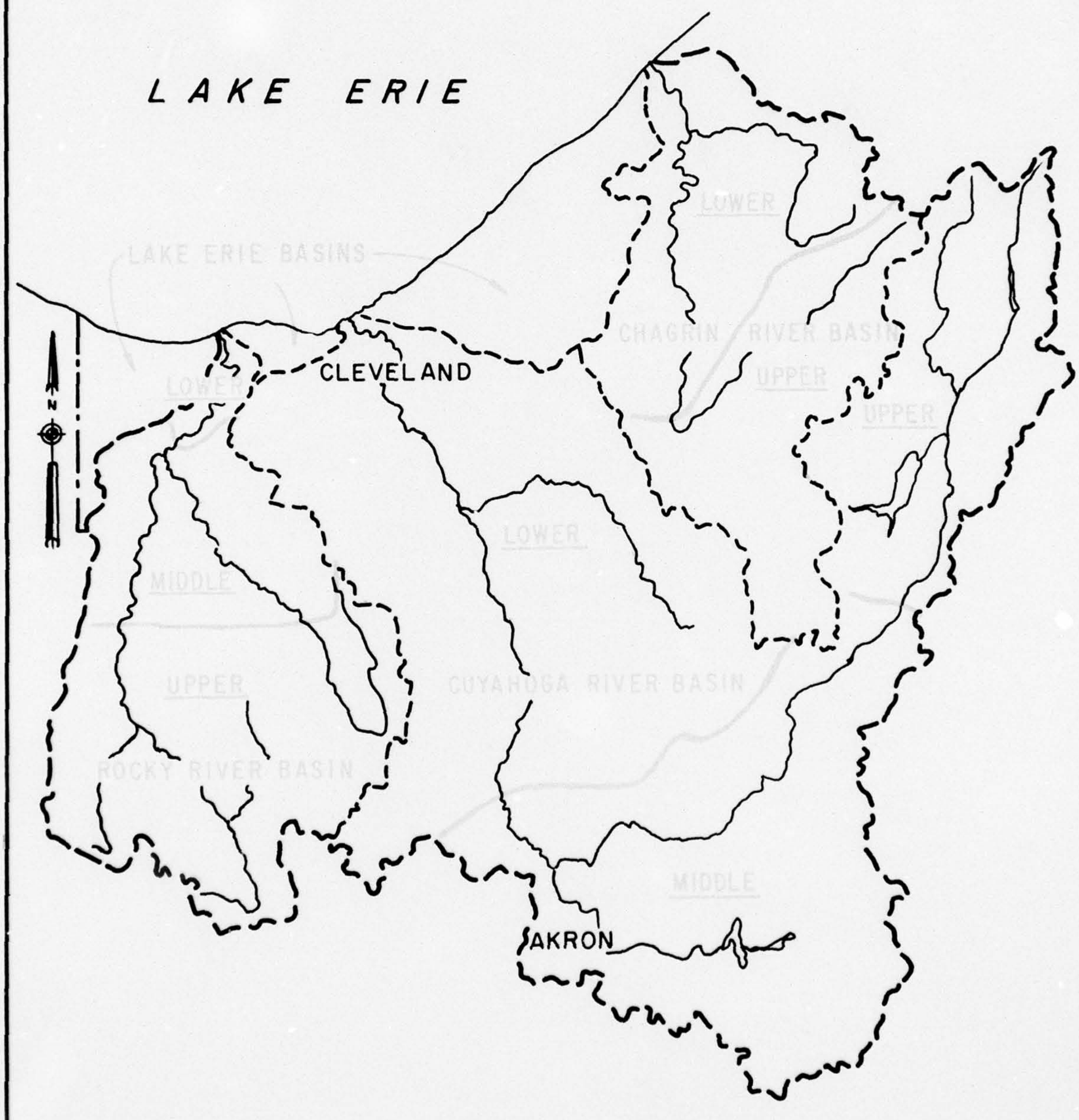
2. Structure of the Region.

With the water quality criteria and treatment choices available for use, the study attention was turned to the examination of the region, its population trends and the general makeup of the individual river basins. The general characteristics of the region and future trends are discussed in Chapter 3. The basin areas were divided into upper, middle, and lower regions based upon land use and population densities as projected over the period covered by the study. These basin subdivisions are shown on Figure 13. System configuration could now be defined in terms of the physical structure of the region, as well as the level of treatment and the technologies that best meet the need.

The amount of present and projected urbanization in each of the three regions was found to be very useful in breaking the alternatives into logical component parts. These components, when optimized for the three technologies, could then be considered on their own or in combination with other plans utilizing that technology, giving a broad range of alternative possibilities and system flexibility.

3. Water Quality Criteria.

The degree of improvement in water quality was considered by [illegible] different levels of treatment as discussed in Chapter 2.



RIVER BASIN SUBDIVISIONS

FIGURE 13

Plans were developed to meet Level I and Level II water quality (see Figures 1 and 2). The Northeast Ohio Water Development Plan configuration, as described in Chapter 6, meets current water quality criteria and provides a basis for plan formulation to meet higher effluent quality.

Four plans were initially developed to meet the Level I water quality criteria. Of these, one was the basic Northeast Ohio Water Development Plan, another was a plan treating all effluent on land. The other two were combination plans utilizing major and minor amounts of land for treatment. The land treatment components utilized existing secondary treatment plants. Subsequently, these four plans were modified so as to achieve Level II water quality criteria. An additional plan was formulated to compare the effect of greater centralization of advanced treatment plants on these systems. Finally, three plans were developed to compare the effects of the different pure treatment technologies on system design. The Northeast Ohio Water Development Plan combined the use of physical-chemical and biological plants for advanced treatment. Therefore, a plan was developed that contained only physical-chemical plants and another was developed that contained only biological plants. The third plan was a pure land treatment plan including the use of aerated lagoons for the secondary treatment portion of the system.

These twelve plans provided a full range of systems for comparison of costs and impacts of the various technologies and treatment levels.

C. Evaluation Process

In general terms, the purpose of evaluation is to discover, in advance of final plans or construction, any potential for ecological mishap or disaster, any technical flaw or inadequacy, and any opportunity for protection or enhancement of the larger social and physical environment. Identification of deficiencies or adverse effects was followed by investigation and by iterative processes, to achieve modification or refinement of plans toward greater harmony and efficiency.

For this study, the principal purposes of evaluation were:

1. To define the current conditions of the Three Rivers Watershed area as a prelude to the identification of the social, economic, ecological, public health, and aesthetic changes resulting from implementation of any alternative wastewater management plan.

2. To provide, during the planning process, information to the planner to enable the refinement of plan components by identifying detrimental impacts from specific components and suggesting revisions to enhance harmony with the social and physical environment.

3. To provide the decision makers with an array of impacts, organized by alternative plans, showing how each affects the social and physical environment. This enabled the comparison and selection among alternatives based on the relative desirability of the alternative plans.

4. To preserve an orientation toward the future by due regard for long-term maintenance and enhancement of the environment as opposed

to short-term local use; by discovery and identification of irreversible ecological effects; by consideration of the effect on resources and energy, relacing expected demand to resource capabilities; and by concern for the increasing value of scarce natural resources.

The initial alternatives were evaluated on the basis of:

(a) System performance.

(b) Financial cost.

(c) Environmental, social, and economic impact.

(d) Institutional analysis.

(e) Public opinion.

The initial engineering feasibility was discussed in the Feasibility Study and will not be further discussed in this summary. All designs incorporated in the alternatives are feasible from an engineering standpoint.

The five impact categories used in this study are social, economic, ecological, public health, and aesthetics. Initially a broad range of alternatives were identified in light of a thorough evaluation of costs, effectiveness, and indirect social and environmental impacts. Alternative system components were specifically evaluated on the basis of how they handle municipal, industrial, and urban storm runoff and the sludge produced from this treatment.

Institutional concerns were not limited to the governmental bodies affected but also to the possible establishment of regulations,

laws, restrictions, and good operation and maintenance practice. Further, the concern of multiple use of land for treatment and crop production was analyzed. Summaries of the evaluation of the twelve alternatives appear in Chapter 6. The complete evaluation appears in Appendix VI.

Based on the initial formulation, evaluation, and public involvement, several alternatives were selected for refinement by time-phasing, optimization of plant siting, and compliance with on-going planning by local entities. The Northeast Ohio Water Development Plan configuration was used as a basis for considering the incremental benefits (tangible and intangible) and costs of going from Level I to Level II. After formulating these plans (as discussed in Chapter 7), an examination of each was made with regard to the evaluation parameters, and the impacts of each on impacted groups of the public. Here, impacted public means the taxpayers or residents of the study area, the residents of the State of Ohio outside the study area, the residents of the Lake Erie Region, and the national and international communities affected by these plans. A display of the significant impacts and the public sectors impacted upon is presented in Chapter 7. From these identified impacts, a table of preference sets for choice among the various plans was developed to assist the decision-making process and appears in Chapter 8.

D. How the Public Was Involved

Although the normal series of formal public meetings were conducted as the wastewater management study progressed, emphasis was placed on the informal workshop forum with representatives from

all public sectors upon which the study results might impact. The workshops were intended to ascertain the views of a broad representation among Ohio's citizens, in addition to local governments and interest groups.

Initial public meetings were held 18 and 19 January 1972 in Akron and Cleveland, respectively. In the interim period before the formulation stage public meetings in December 1972, about 15 invitations for presentations of the study's progress were fulfilled, primarily within the Three Rivers Watershed area and in the counties identified in the feasibility report as having soils suitable for land treatment of wastewater.

"The Purewater Press," a periodic newsletter, constituted the principal public communication medium during the plan formulation phase of the study. The "Press" announced the award of the contracts for each portion of the study, identified the various wastewater treatment technologies under consideration, reported the progress of the study, and reprinted articles related to water pollution control. The initial mailing list of about 1,000 has grown to in excess of 2,500. The attendees at meetings held during the study were added to the mailing list as the study progressed.

An intensified public involvement program followed the formulation of the twelve alternative plans. Twelve workshops and presentations, the first three of which were held in counties containing prospective land treatment sites and two others that were held in a potential

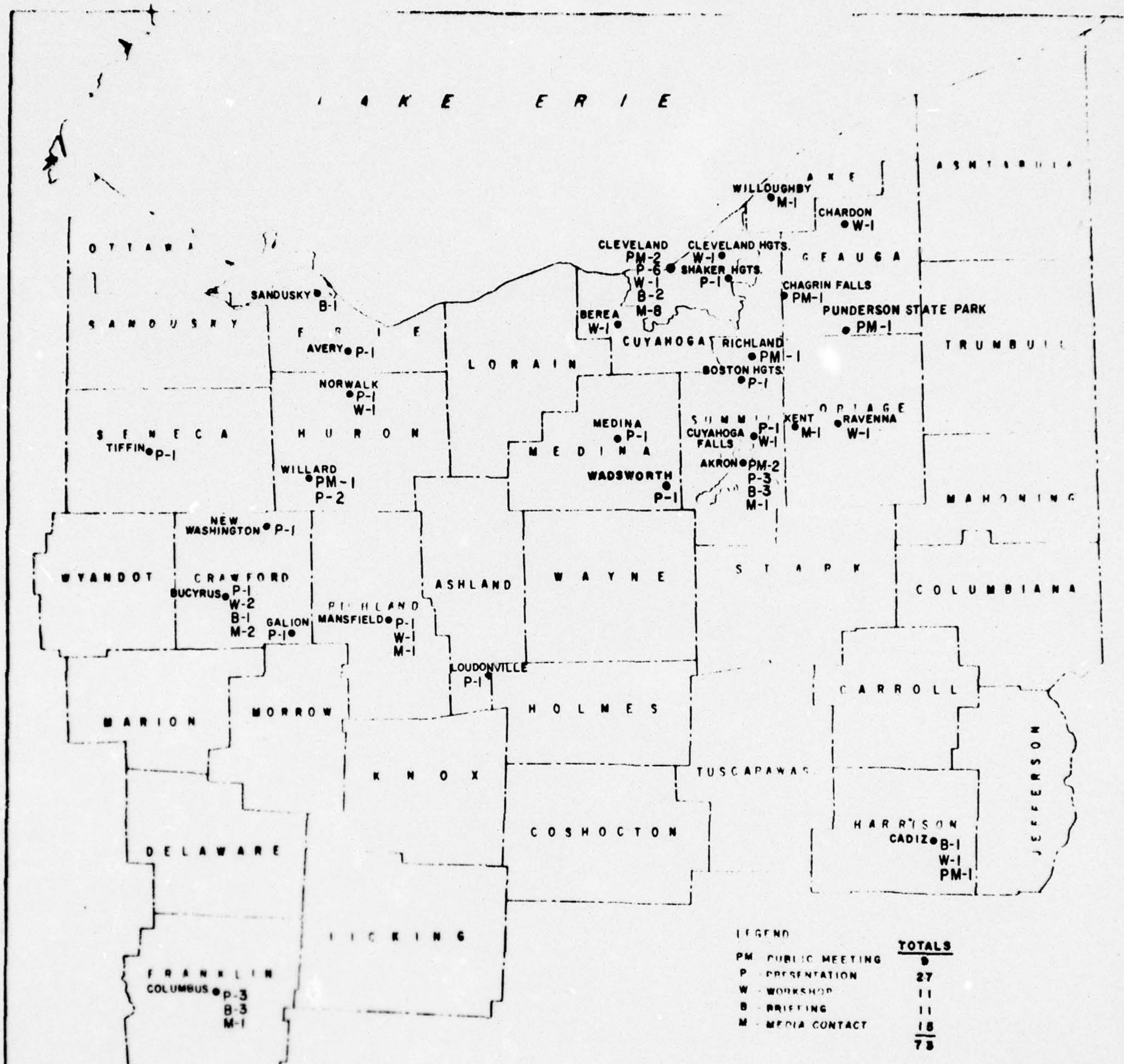
sludge management area, preceded the three formulation stage public meetings.

An additional 15 workshrps and presentations were held subsequent to the public meetings, most of which resulted from follow-up requests from farmer groups and farm organizations, county commissioners, chambers of commerce, service clubs, university groups, conservation groups, and local government officials.

Four final public meetings were conducted to ascertain the public review of the four plans selected for final consideration. The transcripts of those meetings are included in Appendix VIII. The contributions of the public to the review of this report are reflected in its Conclusions (Chapter 9).

Figure 14 displays the types and locations of the contacts with the public during the formulation stage of the study. The views of the various public sectors towards the study and the alternative plans are discussed in the Chapters 6 and 7.

During the course of the public involvement program, several concerns relating to water quality, land treatment technology, and public health were articulated by the various publics. These concerns, together with the environmental evaluation, influenced the reformulation of alternatives and selection of plans. Specific public concerns are identified and discussed in Chapter 6 as they relate to specific alternatives. A more detailed discussion of the public involvement program, including samples of correspondence and presentation material, is contained in Appendix VIII.



PUBLIC CONTACTS IN OHIO

FIGURE 14

CHAPTER 6

ALTERNATIVES CONSIDERED

A. Introduction

The purpose of this chapter is to summarize the specific formulation and evaluation of the twelve alternative plans that were developed in Phase 2. As Chapter 5 discusses, the twelve alternatives were developed sequentially, resulting from interactions between the designers and the evaluators. The descriptions of the formulation and evaluation of the alternatives will follow the sequence of plan development.

B. Development of Management Options

Prior to the development of specific area-wide wastewater management alternatives, sets of options were developed for industrial wastewater, urban stormwater runoff, and sludge management. These options were incorporated into the area-wide wastewater management alternatives in a variety of combinations, allowing the evaluation of those options in relation to total wastewater management systems.

1. Industrial Wastewater Treatment.

For the formulation of industrial wastewater treatment options, the industrial discharges were separated into two general categories: 1) those discharged directly into a waterway and 2) those discharged into a municipal sewerage system. The industrial wastewater treatment options were developed to include complete treatment of directly discharged wastewaters to the appropriate Level I or Level II criteria and pre-treatment of wastewaters discharged into sewer systems to levels which meet the compatibility criteria.

The compatibility criteria are:

1) That any constituent that may interfere with the reliable performance of the municipal treatment plant receiving that wastewater flow must be reduced by pretreatment at the industry to such a concentration that interference is prevented, and

2) That any constituent not reduced in the municipal treatment plant receiving that flow to the level required by the Level I or Level II criteria must be reduced by pretreatment to comply with those criteria prior to discharge to the sewer.

Each industrial wastewater treatment option provides for complete treatment of the directly discharged wastewaters to the appropriate level, but the degree of pretreatment of that proportion discharged to sewerage systems varies according to the compatibility criteria associated with the technology selected for municipal wastewater treatment.

Option 1 provides sufficient retreatment of industrial wastewater so it is acceptable to sewage treatment systems using any of the three technologies considered for municipal treatment, designed to meet level 1 design criteria.

Option 3 provides pretreatment compatible with municipal wastewater treatment facilities using any of the three technologies designed to meet the Level II design criteria.

Option 4 is designed to be compatible only with the land treatment technology. The pretreatment included in this option excludes the removal of heavy metals prior to discharge to sewerage systems because of the ability of the soil to absorb those metals to the extent required to meet the Level II criteria. However, the treatment processes used in Option 4 to reduce dissolved solids to the appropriate level simultaneously reduce the concentrations of heavy metals.

Therefore, to take full advantage of the capability of the land treatment technology to remove heavy metals to such an extent that Level II criteria are met, Option 5 was formulated. In order to allow those heavy metals to enter the sewers for transport to the municipal land treatment site, processes necessary to reduce the dissolved solids to the level consistent with the pretreatment criteria must be omitted. Therefore, both heavy metals and dissolved solids would be transported to the land.

A final industrial treatment, Option 2, was formulated to examine the potential benefits to industry and the public from maximizing the internal recycle and reuse of water and wastewater, while meeting Level II criteria. This option projects a reduction of wastewater flow from industry to approximately 35 percent of that from any of the previous four options.

Table 13 displays the five industrial wastewater treatment options, the treatment criteria that each meets, the municipal treatment technology

with which each is compatible, and the cost to industry of applying each throughout the Three Rivers Watershed.

TABLE 13
INDUSTRIAL WASTEWATER TREATMENT OPTIONS

Industrial Wastewater Treatment Option	Treatment Criteria	Compatible Technologies	Average Annual Cost (Million $/Yr)
1	Level I	Advanced Biological, Physical-Chemical, and Land Treatment	41
2	Level II	Advanced Biological, Physical-Chemical, and Land Treatment	55
3	Level II	Advanced Biological, Physical-Chemical, and Land Treatment	65
4	Level II	Land Treatment	62
5	Level II*	Land Treatment	36

* NOTE: Total dissolved solids pretreatment criteria are violated to allow discharge of heavy metals to municipal land treatment systems.

It should be noted that all municipal systems in the twelve alternative plans provide sufficient capacity to accept the flows of pretreated industrial wastewater projected in Options 1, 3, 4, and 5, not the reduced flow projected in Option 2. Therefore, any of these systems would be capable of treating the maximum volumes of wastewater projected.

2. Urban Stormwater Collection and Treatment.

Because of the random nature of rainfall occurrence, duration, and intensity, systems to collect the resulting stormwater runoff must be

expected to be overloaded occasionally. The frequency of that overloaded condition can be controlled through the design capacity of the system. The proportion of the average annual urban stormwater runoff that should be collected for treatment was determined by examining the relationships among the percentage of runoff collected and the cost and effectiveness of the treatment system. The combined information displayed in Figure 15 led to the decision to develop systems having the capacity to collect and treat, over the year, 97.3 percent of the average annual urban stormwater runoff. Figure 15 shows, for example, that if the percentage of stormwater collected for treatment were increased to 99 percent, cost would be increased by 30 percent, with a resultant increase in suspended solids removal of less than 2 percent. Other pollution parameters demonstrate a similar relationship.

Like total quantity, the frequency of overflow is important to the stream environment. The system capacity selected will only allow urban stormwater runoff to escape an average of once a year. Even that overflow is partially treated. Using the land use projections discussed in Chapter 3, those drainage basins were identified that are projected to experience sufficient development by 2020 to be classified as urban. The 162 basins identified are displayed in Figure 16.

Urban stormwater treatment options include: 1) local collection and treatment followed by direct discharge to the stream, 2) collection and storage followed by treatment in a municipal facility during periods

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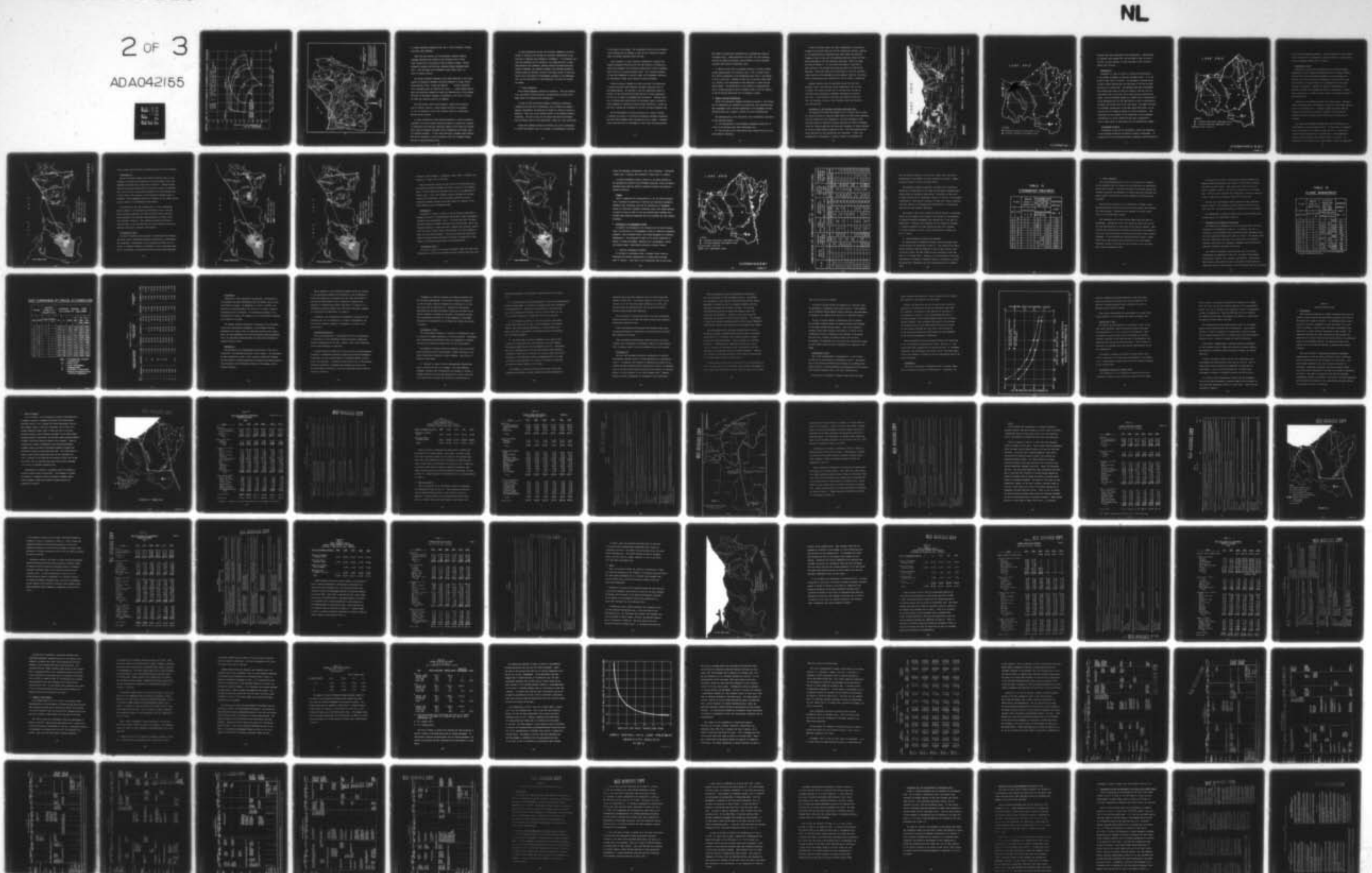


CAPITAL COST VS. EFFECTIVENESS OF STORMWATER RUNOFF TREATMENT

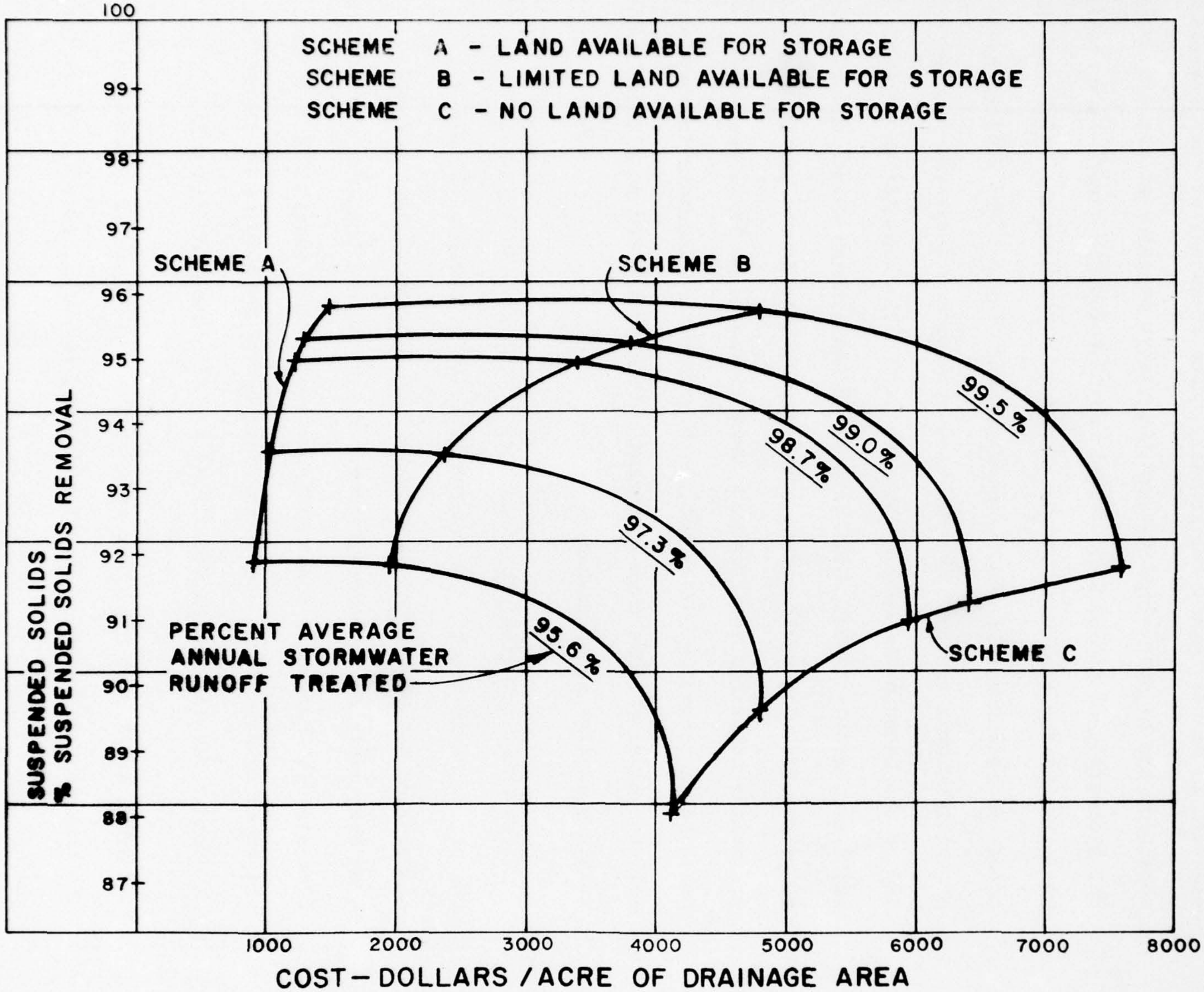


FIGURE 15

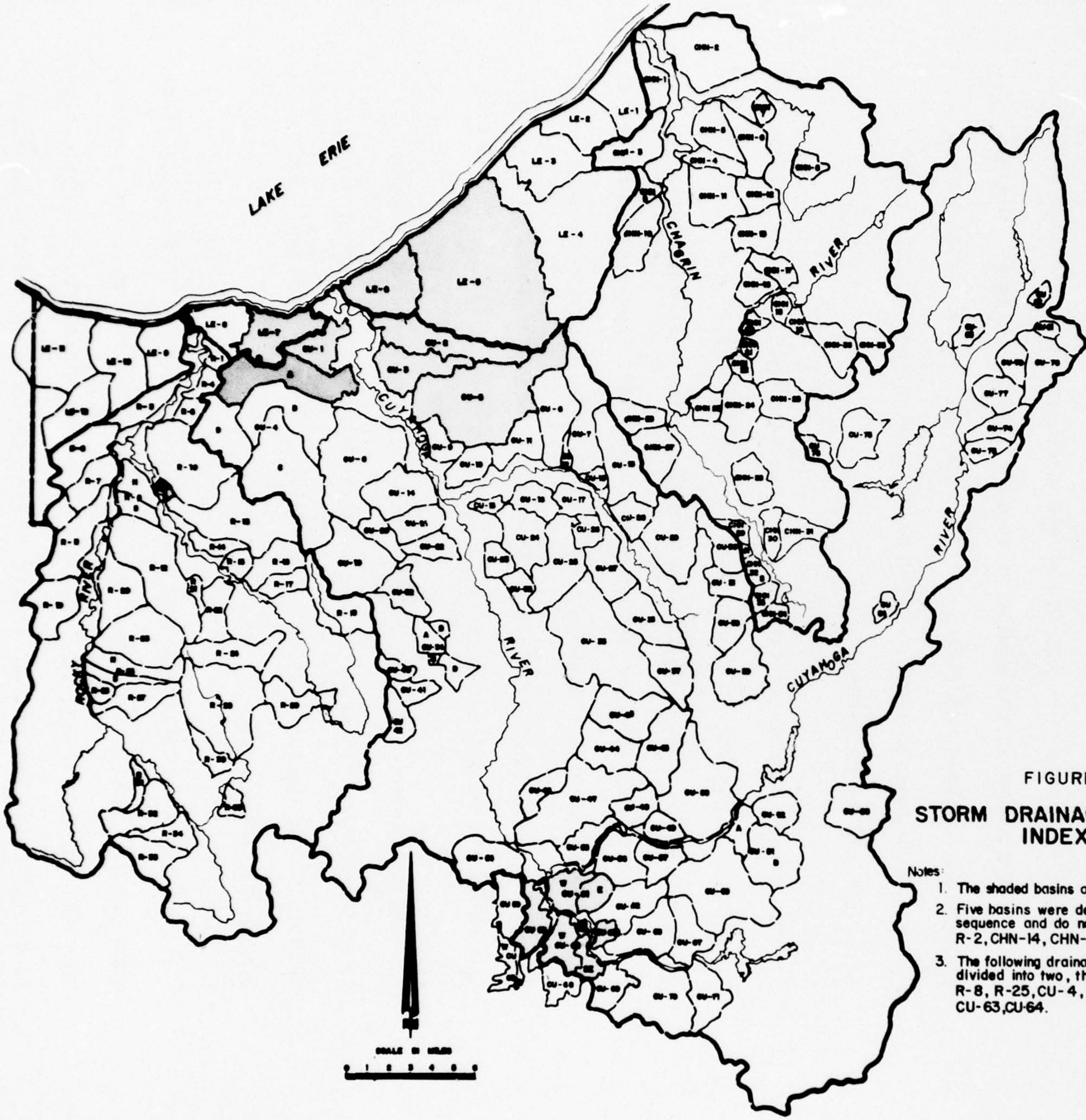


FIGURE 16

STORM DRAINAGE DISTRICTS INDEX MAP

Notes:

1. The shaded basins are combined sewer systems
2. Five basins were deleted from the numbering sequence and do not appear on this map: R-2, CHN-14, CHN-15, CU-72, and CU-80.
3. The following drainage basins have been subdivided into two, three or four parts: CHN-32, R-8, R-25, CU-4, CU-34, CU-51, CU-61, CU-63, CU-64.

of reduced municipal wastewater flow, and 3) local collection, storage, and direct land treatment.

Under the first option, the local separate, physical-chemical treatment facilities are located at the discharge site of storm sewer systems and at the mouths of small tributary streams. Minimal storage is required, and few water transfers between drainage basins occur. This procedure can be designed to meet either Level I or Level II quality criteria.

The second stormwater treatment option takes advantage of the excess capacity of municipal treatment facilities necessary to accept fluctuating municipal flows. During low municipal flow periods, stormwater can be introduced into the facility for treatment. Large storage requirements and interbasin transfers of water are characteristic of this system. The level of stormwater treatment is equivalent to the level of quality for which the municipal facility is designed.

The third option, direct land treatment, produces water meeting Level II quality criteria. Large storage facilities are necessary to hold the stormwater, since land treatment cannot be accomplished during rainfall periods.

In those alternatives having advanced biological or physical-chemical components, the choice between separate stormwater treatment and treatment in combination with municipal wastewater depends on the trade-offs between plant costs for separate treatment versus transmission and storage costs for combined treatment. In most cases, municipal treatment plant capacity need not be increased to accept stormwater runoff for treatment during periods of reduced municipal flow.

In those alternatives having land treatment components, the availability of suitable soils becomes an overriding consideration in the selection of separate land treatment of stormwater. If an adjacent suitable land treatment site is available, cost comparisons must be made among separate land treatment, separate advanced biological/physical-chemical treatment, and combined treatment with municipal wastewater. Suitable lands are available in much of the upper regions of the river basins, but as the density of development increases in the downstream area, and the availability of land diminishes, the other two options are needed.

3. Sludge Management.

Three sludge management options are considered. They are incineration, agricultural land application, and application to barren strip-mined lands for restoration and revegetation.

In order to make the physical-chemical technology economically competitive with the other technologies, and to minimize its massive chemical requirements, incineration of sludge for chemical recovery is mandatory. Thus, ash is the residual product of the physical-chemical technology. Such ash is very low in organic materials and nutrients and has reduced value for land application, except as a soil conditioner.

Sludge from advanced biological facilities can also be incinerated to reduce the tonnage of ash to be handled to approximately 45 percent

of the weight of the sludge. The incinerators included in the alternatives reported here are designed to meet all the existing and anticipated air quality standards within the area.

After treatment to reduce bacterial contamination, sludges from advanced biological facilities and from the biological processes preceding land treatment can be applied to agricultural lands to increase their fertility and rebuild depleted soils. This procedure requires no long-term commitment of specific lands, since permanent facilities are unnecessary; sludge can be applied by mobile equipment.

Treated biological sludges have been found ideal for application to barren strip mine spoil material, achieving vegetative cover in one growing season. The location of the Ohio Appalachian region in relation to the Three Rivers Watershed provided a unique opportunity for the use of sludge in stripmined land restoration. Pipeline transport to distribution points within the stripmined region, followed by truck transport to restoration sites provides flexibility. As much as 300 tons of sludge can be applied to an acre of barren stripmined land.

The Ohio Department of Natural Resources has a project underway to develop the concept of collectively mitigating stripmine reclamation and solid waste problems, which includes the use of sludge. A possible result from this study is development of solid waste recycling centers

and sludge utilization for reclamation as a complementary system in stripmined areas. Sludge application can follow the land reshaping involved in landfill activities, thus providing a natural landscape protected from erosion by vegetative cover.

It should be noted that the pipeline transport of sludge requires solids concentrations of 10 percent or less. Thus, transport water will also be transported to the Southeastern Ohio area, at the expense of flow to Lake Erie. Transfer of water out of the Great Lakes Basin is a concern of the International Joint Commission of Canada and the United States. The significance of this transfer is minimized when the 4.5 million gallons per day of transport water in 2020 is compared to the 794 million gallons per day of wastewater treated.

C. Range of Initial Alternatives

Within the formulation framework discussed in Chapter 5, the initial set of alternatives was formulated to incorporate, into area-wide wastewater management plans, various combinations of the management options described above and to display a variety of system configurations.

The configurations of the alternatives were significantly influenced by two principal factors:

1) The configuration of the wastewater management system that is a part of the Northeast Ohio Water Development Plan.

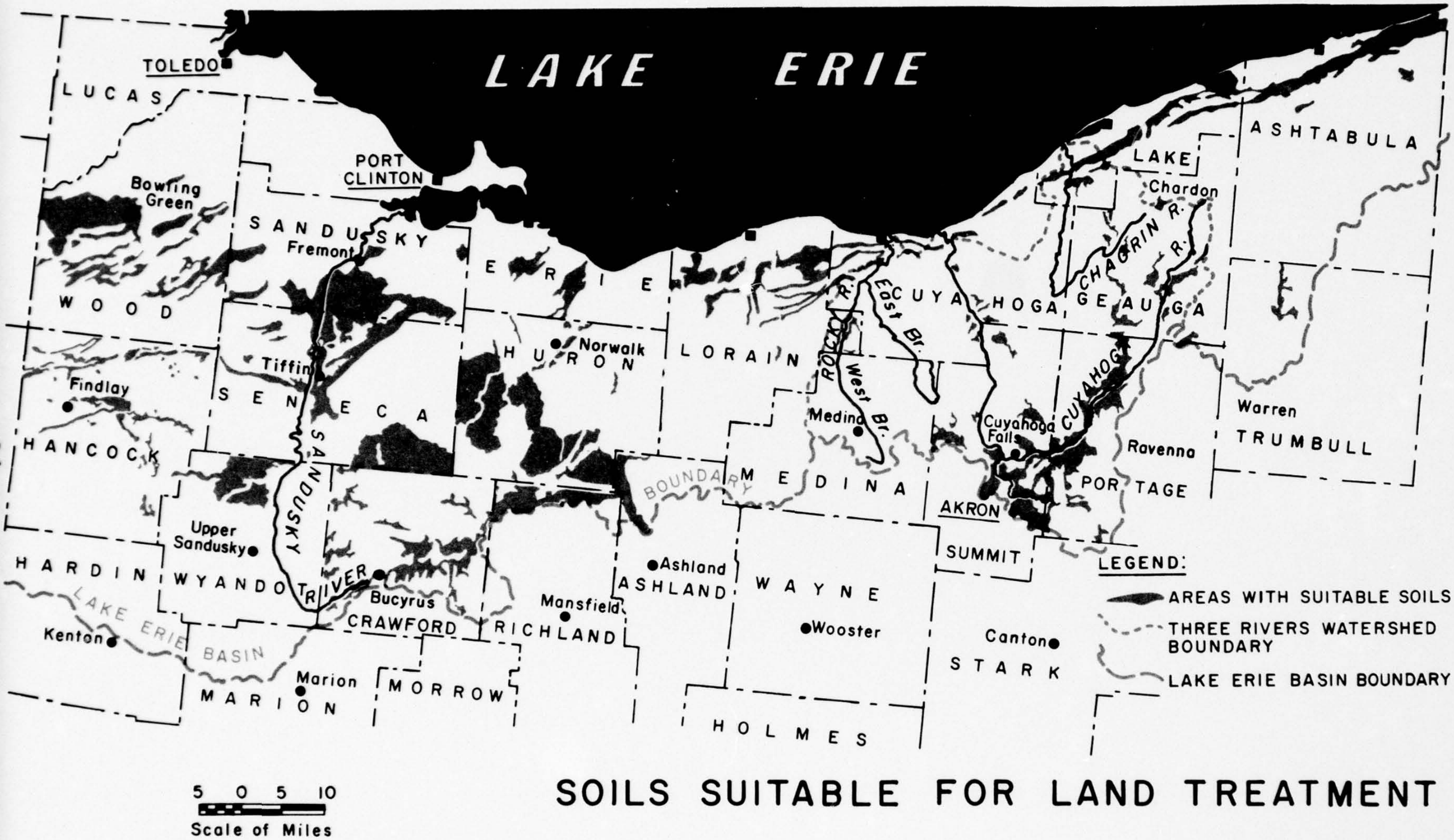
2) The location of land areas having soils suitable for use by the land treatment technology.

A study of existing county soil maps, supplemented by information obtained from the Ohio Office of the Soil Conservation Service, resulted in the identification of sufficient land areas within the Lake Erie Drainage of Ohio to treat all the wastewater generated within the Three Rivers Watershed by the land treatment technology. Those land areas are shown in Figure 17. It can be seen from Figure 17 that only a small portion of the suitable land areas are within the Three Rivers Watershed. Those land areas are not sufficient to treat all the wastewater produced in the Watershed by land treatment; therefore, land areas outside the Watershed were considered for land treatment of wastewater.

Although suitable soils are available outside the Lake Erie Drainage of Ohio, the Feasibility Study demonstrated that the cost of pumping the treated effluent back to the Lake Erie Drainage in compliance with international agreements substantially increased plan costs. Since sufficient land areas are available within the Lake Erie Drainage, studies of land treatment areas were limited to that drainage area.

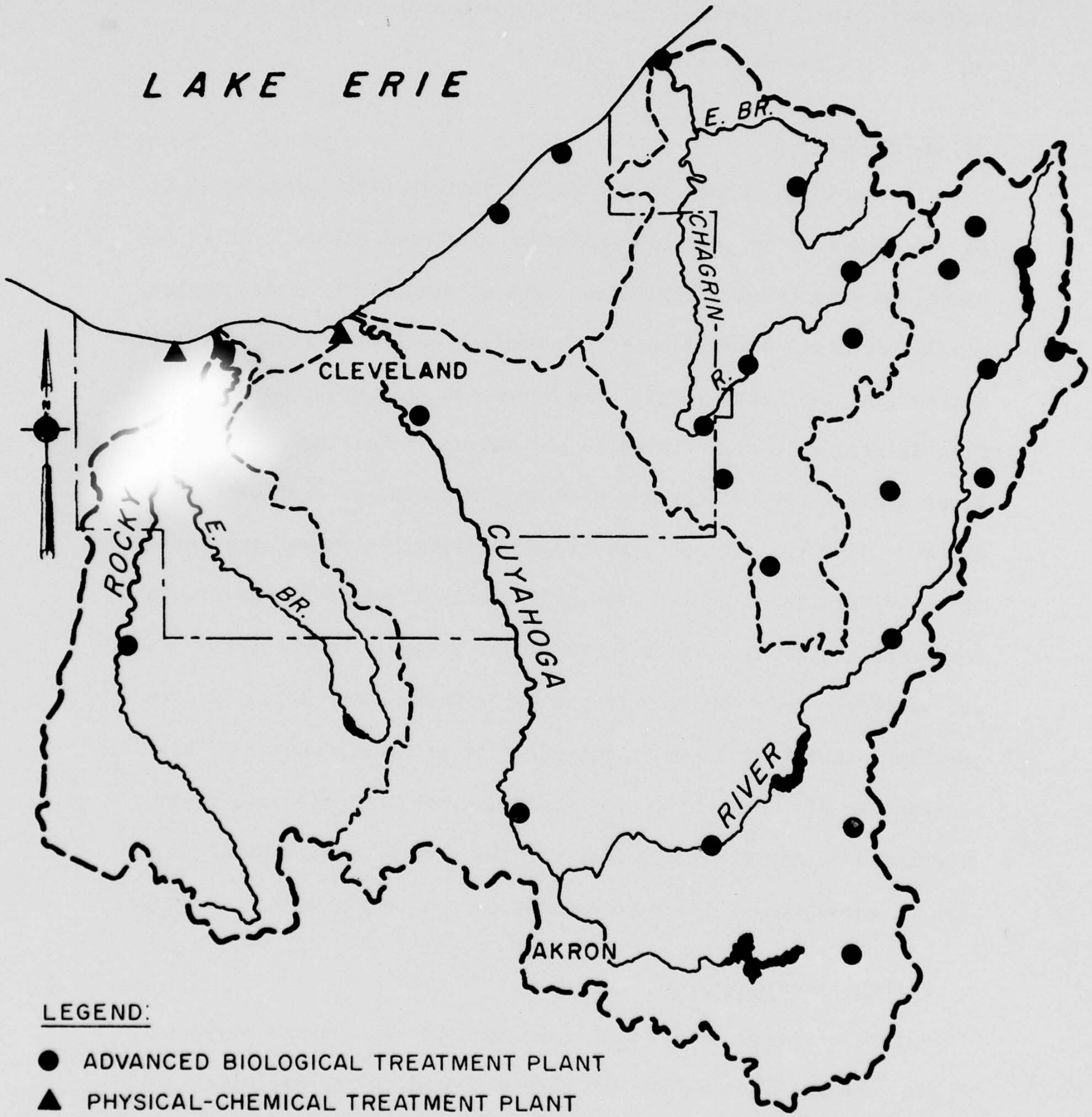
Alternative 1, The Northeast Ohio Water Development Plan

The Northeast Ohio Water Development Plan is currently used to guide the decision process for sanitary sewage within the Three Rivers Watershed, and some actions have been consummated. The plan represents a cost-effective network of advanced biological and physical-chemical treatment plants for treating municipal and industrial wastewater to levels required by the Ohio Stream Quality Standards of 1970. That plan constituted the basis upon which all the alternatives are formulated. In fact, the configuration of Alternative 1, shown in Figure 18, duplicates the



SOILS SUITABLE FOR LAND TREATMENT

FIGURE 17



ALTERNATIVE I

FIGURE 18

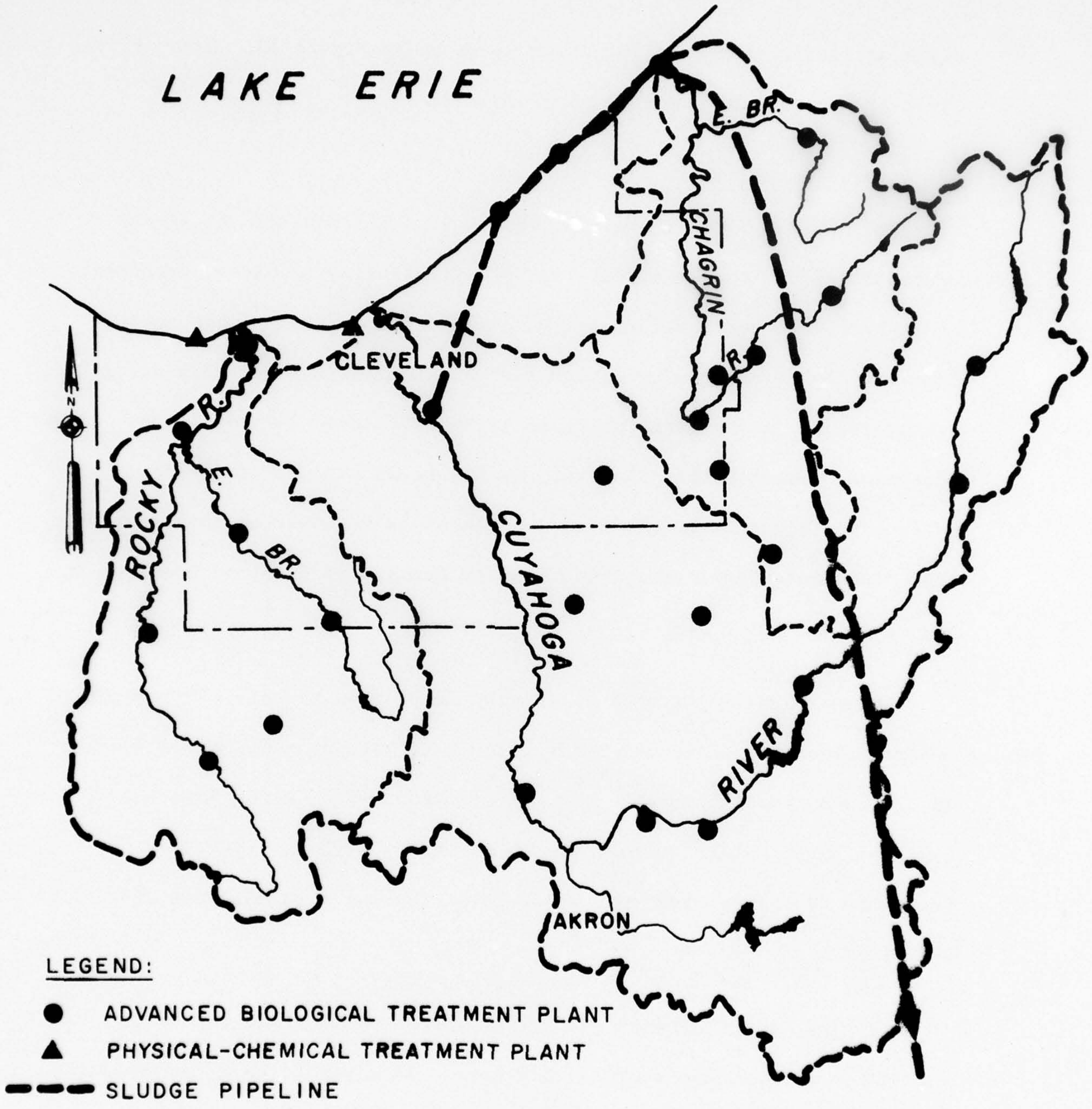
Northeast Ohio Water Development Plan configuration. Modifications in treatment plant designs and costs were made to meet the Level I criteria, and the treatment of urban stormwater runoff was incorporated into the plan.

Alternative 3

Alternative 3, shown in Figure 19, differs from Alternative 1 to accommodate stormwater at municipal treatment plants. It is designed to meet Level II criteria. The alternative includes siting a plant at North Olmstead near the confluence of the East and West Branches of the Rocky River. The Northeast Ohio Water Development Plan deleted this plant to avoid the release of effluent into the lower Rocky River, since that area is lined with an extensive park system. With the effluent treated to a higher level in Alternative 3, it was determined that for flow and quality it would be preferable to reinstate the effluent flow in the lower Rocky. The number of plants was increased, particularly in the upper Rocky River Basin, in conjunction with the changes in method of treating stormwater. This alternative did not provide for the comparison of pure technology alternatives, nor did it provide for the direct comparison of Level I versus Level II costs because of the configuration changes.

Alternatives 10 and 11

Alternatives 10 and 11 were developed to provide the comparison of pure advanced biological and physical-chemical technologies. Alternative 10 is pure advanced biological technology, and Alternative 11



ALTERNATIVES 3, 10, & 11

FIGURE 19

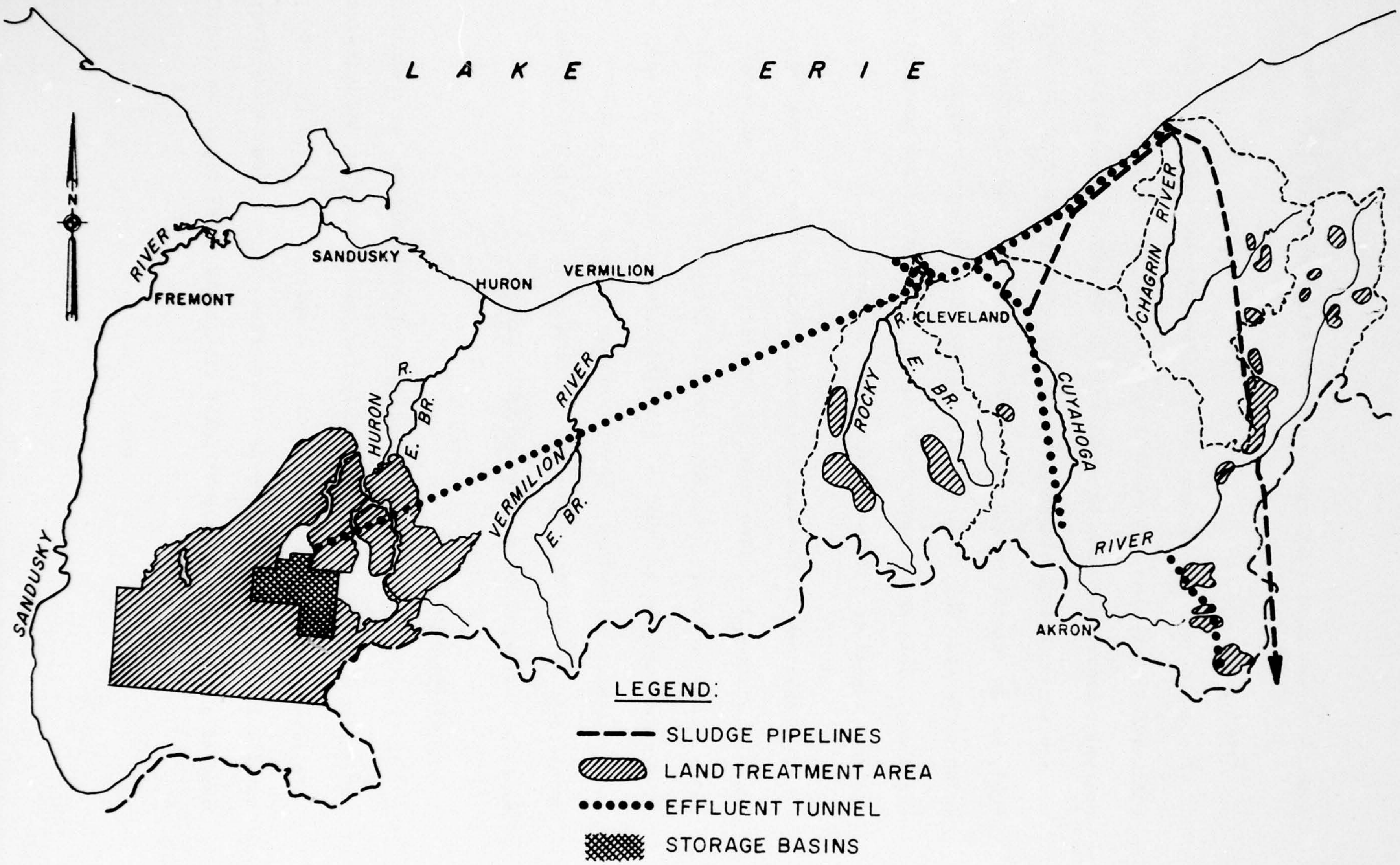
is pure physical-chemical technology. The configurations of both alternatives duplicate that of Alternative 3, shown in Figure 19. Both alternatives are designed to meet Level II criteria.

Alternatives 2 and 4

Alternatives 2 and 4 provide systems with all advanced treatment accomplished by land treatment technology following secondary treatment provided within the Three Rivers Watershed by activated sludge and secondary level physical-chemical technologies. Sufficient soil areas are available in the upper portions of the Watershed for local land treatment of wastewater. However, as Figure 20 demonstrates, the secondary effluent from Cleveland and Akron is transported to a single land treatment area in Crawford, Seneca, Huron, and Richland Counties in Northcentral Ohio.

Transport of the secondary effluent is by deep tunnels. The major tunnel follows the Lake Erie shoreline in Cleveland and proceeds directly to the land treatment area. A tributary tunnel from Akron down the Cuyahoga River valley to collect the secondary effluent from the Cleveland Southerly treatment plant joins the major tunnel west of Cleveland.

The significant difference between these two alternatives is in the treatment of urban stormwater runoff. In Alternative 2, stormwater runoff is treated in local plants to meet the Level I criteria and returned to the local streams. In Alternative 4, the stormwater is treated by land treatment, thus achieving Level II criteria. In Alternative 4, 80 percent of the urban stormwater runoff is transported



ALTERNATIVES 2 & 4

FIGURE 20

from the Three Rivers Watershed to Northcentral Ohio for land treatment.

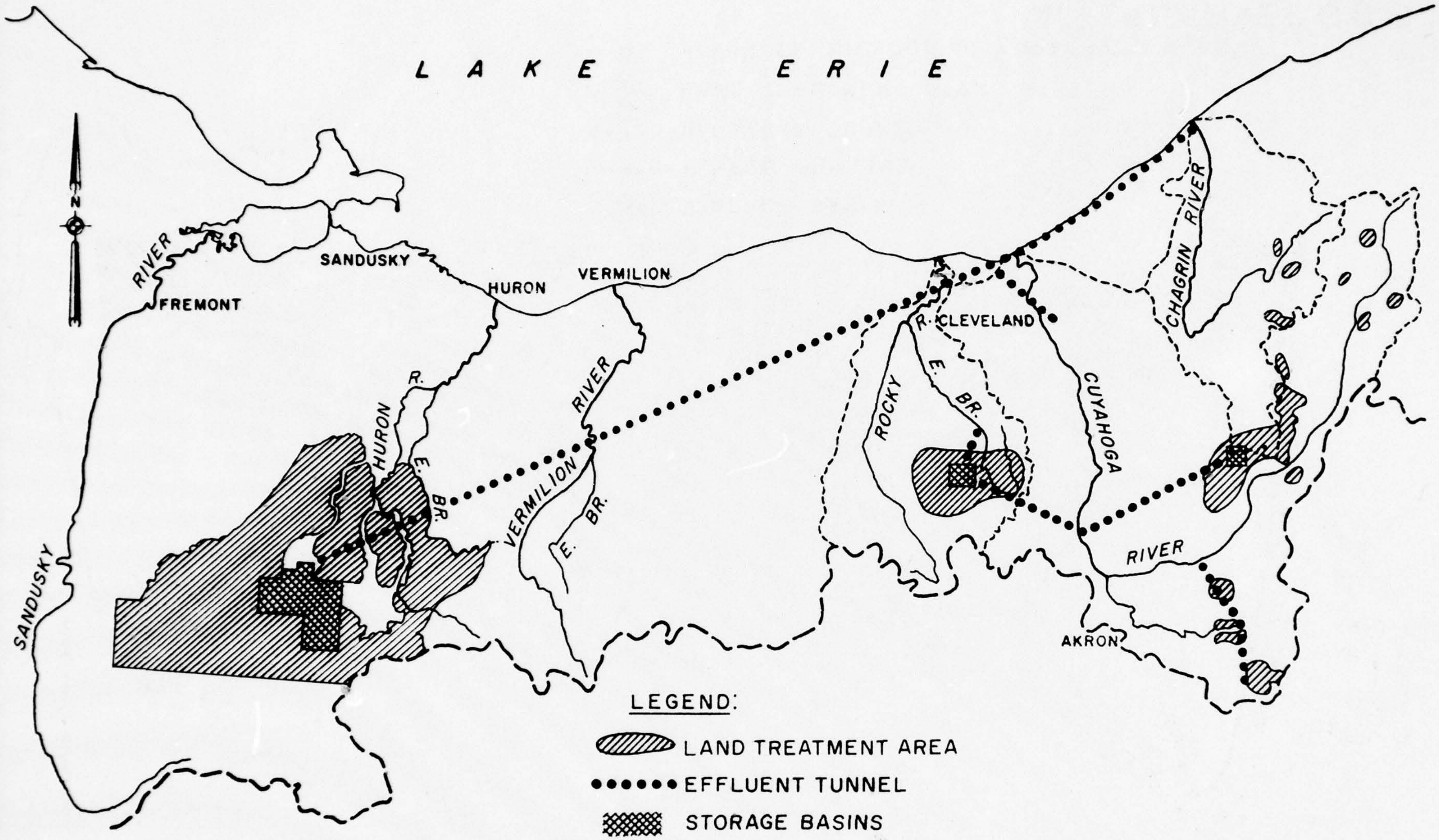
Alternative 12

The use of aerated lagoons for secondary treatment prior to land treatment is introduced in Alternative 12, thus providing a pure land treatment technology plan to meet Level II criteria. Aerated lagoons replace the activated sludge plants in the upper portions of the Watershed, and an aerated lagoon enclave located at the land treatment area in North Central Ohio replaces all the secondary treatment plants in Cleveland. This arrangement requires the transport of raw sewage through the deep tunnel to the Northcentral Ohio enclave.

The locations of the land treatment sites in this alternative, shown in Figure 21, follow those of Alternatives 2 and 4, with one major exception; wastewater from Akron is treated within the Three Rivers Watershed by an overland flow/infiltration variation of the land treatment technology. This treatment component would return renovated water to the Cuyahoga River at a point upstream of the Akron municipal water supply reservoir, Lake Rockwell.

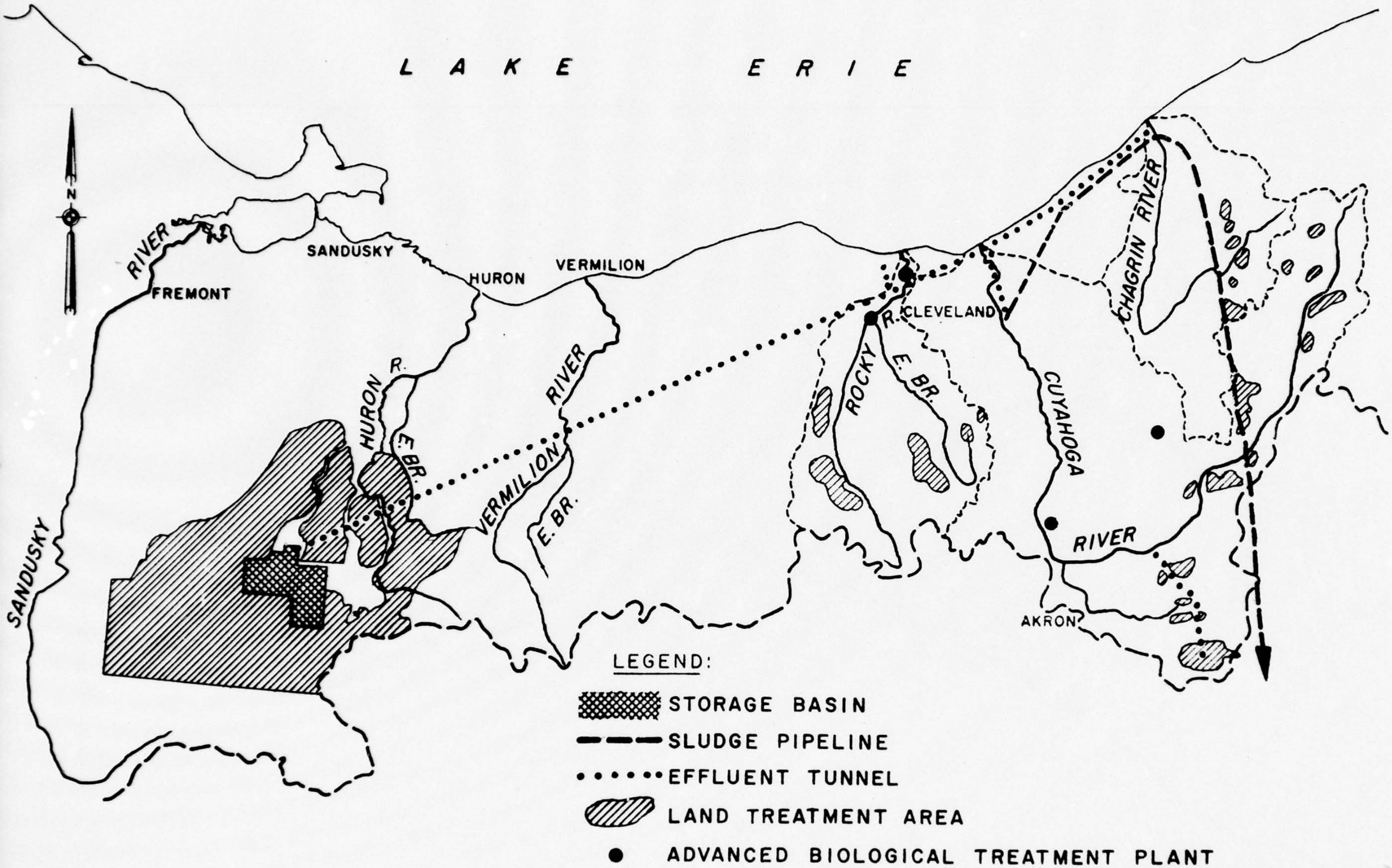
Alternatives 6 and 8

In order to provide a broad spectrum of alternatives for evaluation and public review, alternatives employing combinations of technologies were formulated. Alternatives 6 and 8, displayed in Figure 22, are similar in treatment concepts to Alternatives 2 and 4; secondary treatment of all effluent is accomplished within the Three Rivers Watershed,



ALTERNATIVE 12

FIGURE 21



ALTERNATIVES 6 & 8

FIGURE 22

followed by land treatment. Alternative 6 meets Level I criteria, and Alternative 8 meets Level II criteria.

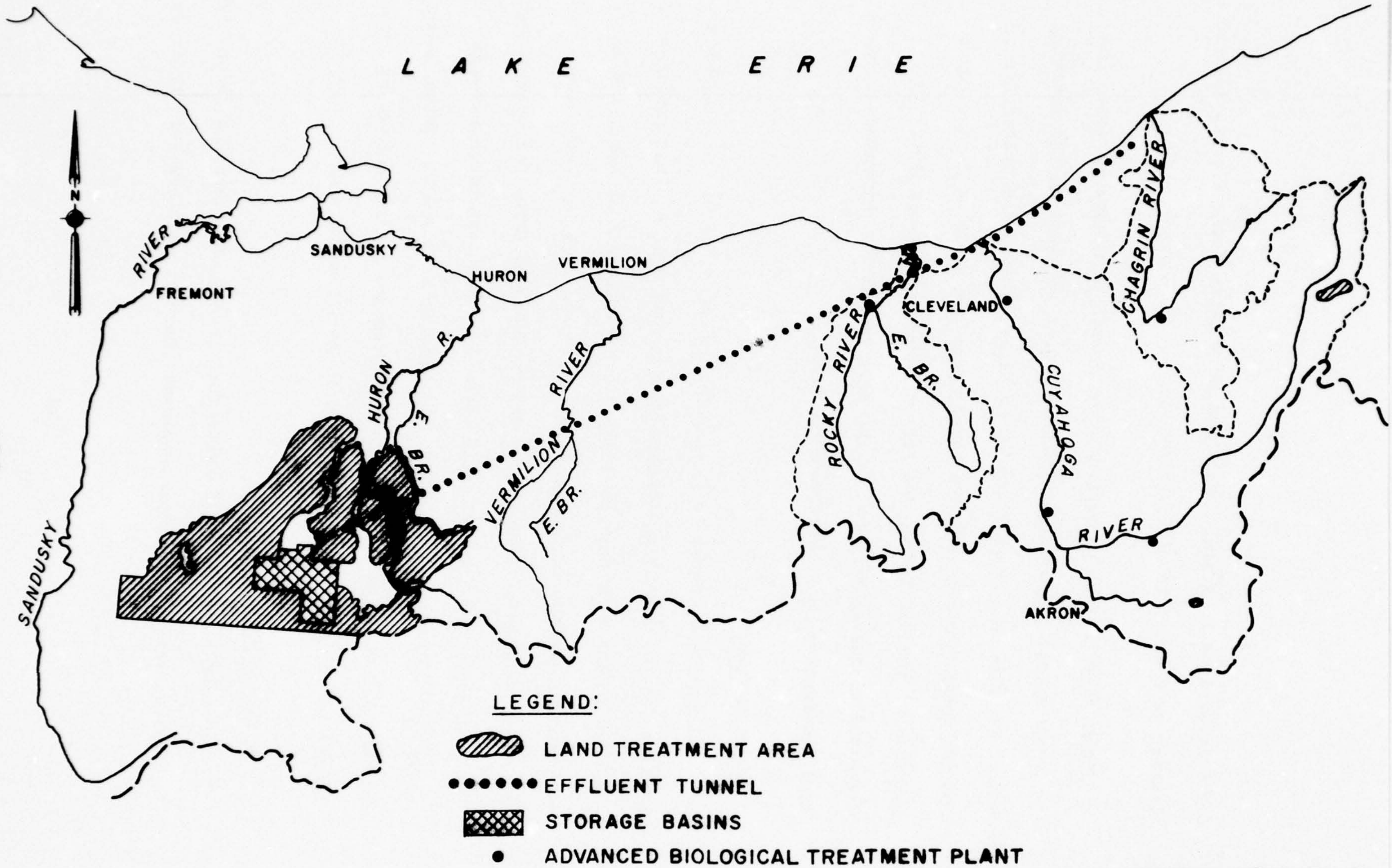
These alternatives provide for the return of renovated water from the advanced biological treatment facilities at Akron to the Cuyahoga River, at North Olmstead to the Rocky River, and to the headwaters of Tinkers Creek. Local land treatment areas are employed in the upper portions of the Watershed, and the secondary treatment plants in Cleveland discharge effluent to the deep tunnel for transport to the land treatment area in Northcentral Ohio.

Alternative 9

Alternative 9, shown in Figure 23, was specifically formulated to examine the results of regionalization beyond the 26 plant configuration included in the Alternatives 1 and 3. To achieve that end, five major advanced biological treatment facilities were sited at Kent, Akron, and Cleveland Southerly to serve the entire Cuyahoga River drainage, Chagrin Falls to serve the Upper Chagrin River drainage, and North Olmstead to serve the Rocky River drainage. The Lake Erie shoreline plants would become collection points from which raw sewage is transported by deep tunnel to an aerated lagoon enclave in Northcentral Ohio.

Alternatives 5 and 7

In order to achieve all wastewater treatment within the Three Rivers Watershed, yet provide land treatment wherever suitable land areas exist



ALTERNATIVE 9

FIGURE 23

within the Watershed, Alternatives 5 and 7 were formulated. Alternative 5 meets Level I criteria, and Alternative 7 meets Level II criteria.

In these alternatives, shown in Figure 24, the upper portions of the Watershed are served by land treatment technology, while the densely populated urban areas are served by advanced biological and physical-chemical facilities.

Summary

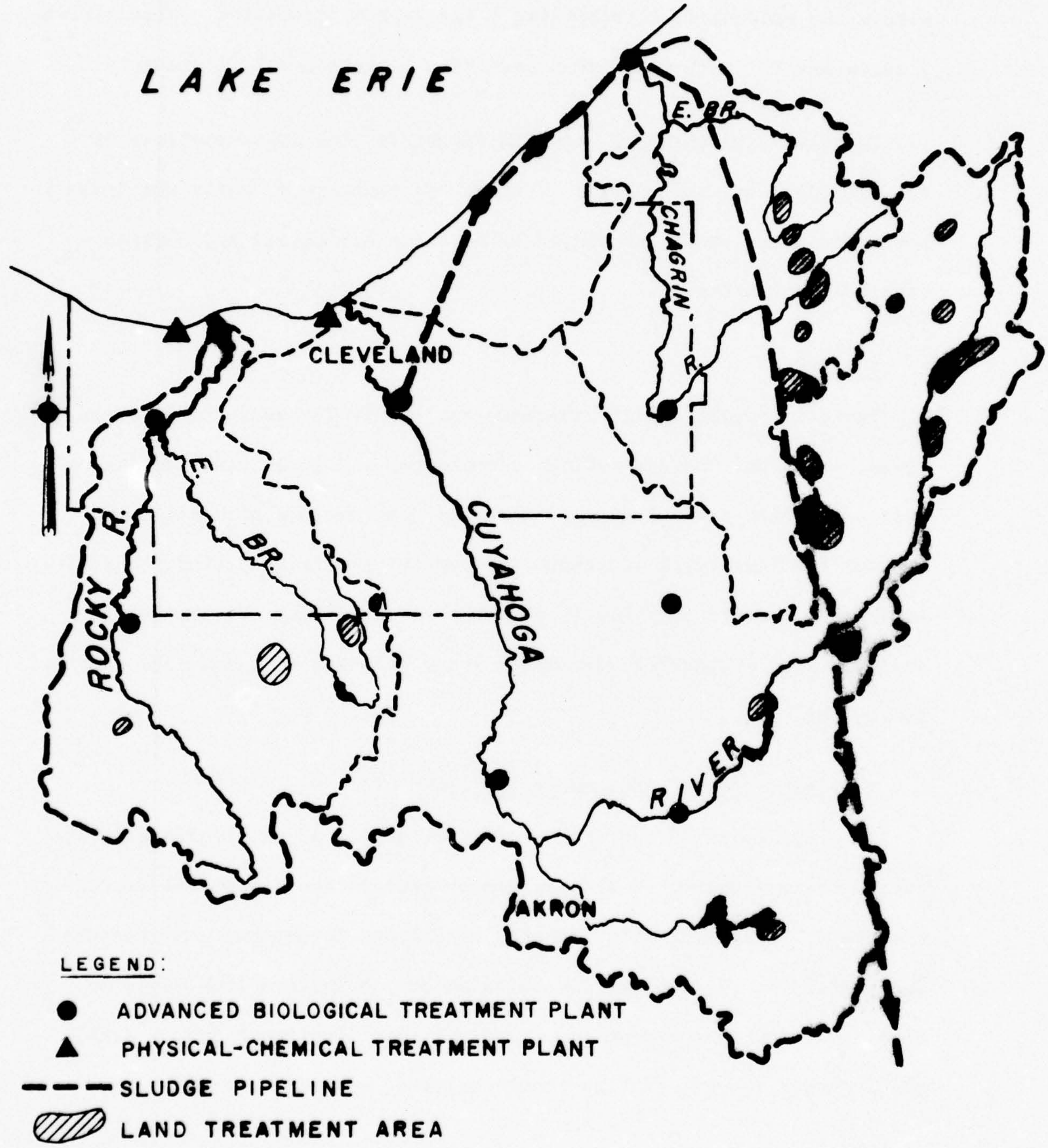
Table 14 summarizes the characteristics of all the initial alternatives, including the proportion of municipal and industrial wastewater treated by each technology, and also the combinations of management options for industrial treatment, stormwater runoff, and sludge handling. It should be noted in Table 14 that the Advanced Waste Treatment Flow includes some industrial wastewater after pre-treatment and some combined stormwater.

D. Evaluation of the Management Options

To simplify the discussion of the evaluation of the twelve alternatives, the evaluation of the management options for industrial wastewater treatment, urban stormwater runoff, and sludge management are presented independently. The evaluation is based on the factors identified in Chapter 5: system performance, financial cost, environmental, social, and economic impact, institutional analysis, and public review.

1. Industrial Wastewater Treatment.

On the basis of performance alone, treatment Option 5 must be eliminated from further consideration in refined plans that meet Level II criteria. Since none of the technologies used in this study



ALTERNATIVES 5 & 7

FIGURE 24

TABLE 14

COMPARISON OF COMPONENTS OF TWELVE ALTERNATIVES

PLAN		WATER QUALITY OBJECTIVE		ADVANCED WASTE TREATMENT FLOW (MGD)			LAND REQUIREMENT AREA (1000 ACRES)		INDUSTRIAL WASTEWATER FLOW MILLION GAL./DAY			SLUDGE HANDLING OPTION DRY TONS PER DAY			STORMWATER TREATMENT BILLION GAL. PER YEAR		
									W/MUNICIPAL		DIRECT TO STREAM	STRIP MINE	LAND APPL.		SEPARATE		COMB.
NO.	TYPE	LEVEL I	LEVEL II	BIOL.	PHYS CHEM	LAND	BASIN	OUTSIDE BASIN	WATER	LAND			SLUDGE	ASH	WATER	LAND	
1	W	✓		730	64				140		786			835	74		
2	L	✓				794	21	146		140	786	477	34		74		
5	C	✓		704	64	26	5		138	2	786	424	31	376	58		16
6	C	✓		401		393	14	70	11	129	786	393	41	247	58		16
3	W		✓	730	64				140		786	330	86	515	10		64
10	W		✓	794					140		786	537	386		10		64
11	W		✓		794				140		786			682	10		64
4	L		✓			794	29	168		140	786	477	34			18	56
12	L		✓			794	54	133		140	786		132			26	48
7	C		✓	704	64	26	7		138	2	786	491	13	411	33	3	38
8	C		✓	194		600	25	123	20	120	786	316	28	284	8	33	33
9	C		✓	466		328	2	76	71	69	786	377		317	5		69

have the inherent capability to effectively reduce dissolved solids, pretreatment at the industry for their reduction is required. Option 5 excluded processes to reduce dissolved solids.

The evaluation revealed uncertainty accociated with unrestricted application of heavy metals on the land, and the public expressed grave concern about the effects of those metals. The ability of the soils to absorb those metals is recognized; however, the impacts of the possible accumulation in crops and the consumers of those crops remains uncertain. Therefore, Option 4 is eliminated from consideration in refined plans employing the land treatment technology.

Since Option 2 must not be assumed for design purposes, as explained earlier in this chapter, only Options 1 and 3 remain for incorporation in areawide wastewater management plans meeting Level I and Level II, respectively. Therefore, the component cost for industrial treatment is constant throughout all plans meeting the same level criteria; $41 million annually for Level I plans and $65 million annually for Level II plans.

2. Urban Stormwater Collection and Treatment.

The combinations of stormwater treatment options associated with each alternative are identified in Table 15. The evaluation and public review provided no clearcut advantage to any of these options, since all options collect the same volumes of urban stormwater runoff and treat it to the same level. Therefore, in the refinement of the plans, combinations of stormwater treatment options are incorporated to match the appropriate technologies and plan configurations and to optimize costs.

TABLE 15

STORMWATER TREATMENT

PLAN		WATER QUALITY OBJECTIVE		STORMWATER TREATMENT BILLION GAL. PER YEAR			AVERAGE ANNUAL COST MIL. $
NO.	TYPE	LEVEL I	LEVEL II	SEPARATE WATER	SEPARATE LAND	COMB.	
1	W	✓		74			123
2	L	✓		74			128
5	C	✓		58		16	174
6	C	✓		58		16	173
3	W		✓	10		64	294
10	W		✓	10		64	292
11	W		✓	10		64	276
4	L		✓		18	56	230
12	L		✓		26	48	184
7	C		✓	33	3	38	203
8	C		✓	8	33	33	202
9	C		✓	5		69	267

3. Sludge Management

From an environmental point of view, the application of sludge to barren stripmined land for restoration and revegetation was established as the favored option. This option provides for recycling organics and nutrients extracted from wastewater to restore land areas otherwise left barren, some of which produce acid mine drainage that pollutes other waterways.

Second priority was given to the application of sludge to local agricultural lands because of the recycle of the organics and nutrients for soil enrichment. Incineration was reserved as the last choice option to be avoided where possible.

Cost comparisons of the three options demonstrated the same relationships. Incineration is the most expensive option, the cost per ton being approximately 1.6 times that of the other two options. Agricultural land application and stripmine land application are similar in cost, with local agricultural land application having a slight economic advantage. In those alternatives employing aerated lagoons in North-central Ohio, agricultural land application is given the economic advantage, because of the long distance from that area to the strip-mined lands in Southeastern Ohio.

The response of the public, particularly in Harrison County, has generally been enthusiastically in support of the stripmine revegetation and restoration option. Some local groups there have already begun to transport sludge to the County for application to stripmine land. Farmers in this area have also indicated an interest in obtaining sludge to improve the agricultural capability of their soil.

The only major institutional problem regarding sludge management options relates to the transport of sludge transport water from the Lake Erie basin, and that was addressed in Section B3 of this Chapter.

The combinations of sludge management options associated with each alternative plan are identified in Table 16.

E. <u>Evaluation of the Range of Alternatives</u>

For simplicity of comparison, the costs associated with the twelve alternatives are summarized in Table 17. In addition, the cost of Alternative 1, which upgrades the Northeast Ohio Water Development Plan, has been estimated for meeting the Level II criteria. The average annual costs for Alternative 1 at Level II are $139 million for municipal treatment, $205 million for stormwater treatment, and $65 million for industrial treatment, totalling $409 million.

The resource requirements associated with each of the twelve alternatives are summarized in Table 18. The chemical requirements include lime, chlorine, alum, polymers, and methanol. Land requirements include those lands that must be purchased for plant sites and those lands used for land treatment, for which purchase may not be necessary.

TABLE 16

SLUDGE MANAGEMENT

PLAN		WATER QUALITY OBJECTIVE		SLUDGE HANDLING OPTION DRY TONS PER DAY			AVERAGE ANNUAL COST MIL. $
NO.	TYPE	LEVEL I	LEVEL II	STRIP MINE	LAND APPL. SLUDGE	LAND APPL. ASH	
1	W	✓				835	27
2	L	✓		477	34		21
5	C	✓		424	31	376	30
6	C	✓		393	41	247	25
3	W		✓	330	86	515	26
10	W		✓	537	386		29
11	W		✓			682	3*
4	L		✓	477	34		19
12	L		✓		132		9
7	C		✓	491	13	411	29
8	C		✓	316	28	284	25
9	C		✓	377		317	16

* This cost includes only disposal. Incineration and its costs are included in the treatment process.

COST COMPARISON OF TWELVE ALTERNATIVES

PLAN		WATER QUALITY OBJECTIVE		AVERAGE ANNUAL COST MILLONS OF DOLLARS					
NO.	TYPE	LEVEL I	LEVEL II	M.	I.	SRO.	M. AND I.	M. AND SRO.	M., I. AND SRO.
1	W	✓		103	41	123	144	226	267
2	L	✓		179	41	128	220	307	248
5	C	✓		110	41	174	151	284	325
6	C	✓		150	41	173	191	323	364
3	W		✓	149	65	294	214	443	508
10	W		✓	149	65	292	214	441	506
11	W		✓	145	65	276	210	421	486
4	L		✓	183	65	230	248	413	478
12	L		✓	141	65	184	206	325	390
7	C		✓	145	65	203	210	348	413
8	C		✓	181	65	202	246	383	448
9	C		✓	167	65	267	232	434	499

SRO. - STORMWATER RUNOFF
I. - INDUSTRIAL
M. - MUNICIPAL
L - LAND TREATMENT
C - COMBINATION
W - WATERWAY DISCHARGE (ADVANCED BIOLOGICAL and/or PHYSICAL-CHEMICAL)

TABLE 17

TABLE 18

RESOURCE REQUIREMENTS IN YEAR 2020

Plan No.	ELECTRIC POWER REQUIREMENT (Megawatt-Hours Per Day)			CHEMICAL REQUIREMENT (Pounds Per Day)			LAND REQUIREMENT (Acres)		
	Wastewater	Stormwater*	Total*	Wastewater	Stormwater	Total	Wastewater	Stormwater	Total
1	2,040		2,040	505,000	---	505,000	2,500	1,000	3,500
2	5,139	212	5,351	118,000	---	118,000	181,500	10,500	192,000
3	2,460		2,460	833,000	238,670	1,071,670	5,300	2,100	7,400
4	5,116	809	5,925	118,000	92,500	210,500	181,800	44,300	226,100
5	2,860		2,860	445,540	24,560	470,100	9,500	1,000	10,500
6	3,348	128	3,476	287,500	8,980	296,480	90,000	7,400	97,400
7	2,246	17	2,263	808,540	220,500	1,029,040	10,300	3,100	13,400
8	4,452	611	5,063	285,100	192,150	477,250	138,100	32,900	171,000
9	3,575	525	4,100	459,000	147,340	606,340	76,200	18,400	94,600
10	2,460		2,460	833,000	238,670	1,071,670	5,300	2,100	7,400
11	2,460		2,460	1,925,000	486,170	2,411,170	5,300	2,100	7,400
12	4,811	1,110	5,921	---	55,570	55,570	176,200	42,000	218,200

Alternative 1

Alternative 1, which duplicates the geographic configuration of the Northeast Ohio Water Development Plan, met general public acceptance within the region. By upgrading it to Level I criteria, the potential for improved aquatic life in most of the Rocky, Cuyahoga, and Chagrin River is increased. In the Navigation Channel of the Cuyahoga River, however, the "Aquatic Life A" stream quality standards will probably be violated.

For numerous reasons, Alternative 1 represents a very acceptable plan from an institutional standpoint: 1) the Northeast Plan was developed by the State of Ohio in cooperation with the local authorities, 2) some components of the Plan are currently being implemented, and 3) all wastewater generated within the Three Rivers Watershed is treated within the basin.

Alternative 3

The variation in the configuration of Alternative 3 from that of Alternative 1 was described previously in this chapter. The performance of this alternative at Level II will provide an additional increment of water quality, therefore enhancing the potential for improved aquatic life, especially in the Navigation Channel of the Cuyahoga, and increased recreation.

Public response to this alternative centered around two factors: 1) the uncertainty regarding the reliability of any technology to prevent the discharge of pollutants into the Lower Rocky River by the plant at North Olmstead and 2) skepticism concerning the necessity to increase water quality from Level I to Level II, at a substantial increase in public cost ($443 million annually, compared to $226 million for Alternative 1 at Level I).

Furthermore, the configuration of Alternative 3 provides no cost advantage over that of Alternative 1 at Level II (Alternative 3 at $443 million annually, compared to Alternative 1 at Level II at $409 million).

<u>Alternatives 10 and 11</u>

Since the configuration of Alternatives 10 and 11 are duplicates of Alternative 3, the environmental impacts and public response regarding configuration are the same. However, significant differences result from differences in technology.

Advanced biological technology is not as suited as physical-chemical technology to communities containing significant industrial wastewater. Furthermore, the pure physical-chemical alternative appears to have a slight cost advantage. It should be noted that the cost of the advanced biological alternative is probably more reliable than that of the physical-chemical alternative, since most experience has been with the biological processes.

Consumption of chemical resources and sludge incineration are the principal disadvantages to the physical-chemical alternative. As Table 18 shows, chemical consumption by Alternative 11 is more than twice that of Alternative 10. Although the incinerators associated with the physical-chemical technology will meet the air quality standards to prevent air pollution, incineration violates the environmental priorities for sludge management by precluding restoration and revegetation of stripmined land through the recycle of sludges.

Alternatives 2 and 4

The land treatment technology, introduced in Alternatives 2 and 4, provides the maximum opportunity to recycle nutrients. Furthermore, these alternatives significantly reduce the consumption of chemical resources for wastewater treatment and for crop fertilization.

Environmental evaluation identified numerous factors of significance associated with the configuration of these alternatives, and these factors were reinforced by public response. The factors of greatest concern were:

1) Transport of sewage from the Cleveland-Akron Metropolitan area to Northcentral Ohio for treatment. The rural community residents interpret this configuration as an attempt to transfer a problem generated within the metropolitan area to their rural area. Valid institutional problems were identified, specifically the

coordinated management of the system to treat wastewater and produce crops.

2) The single massive land area necessary to improve cost-effectiveness limits the development of the system to include neighboring communities in Northcentral Ohio. Furthermore, the advantage of providing open space, thus limiting urban sprawl, which is a characteristic of the land treatment technology, is diminished by this configuration.

3) The purchase acquisition of the land treatment areas would significantly reduce the tax base of the Northcentral Ohio Counties. However, this study proposes alternatives to land purchase, even though that cost is included in all alternative plan cost estimates for comparative purposes.

4) The application of treated wastewater to the land at rates as high as 75 inches per year, which improves cost-effectiveness, necessitates modifications in farm management practices. Furthermore, the flow of renovated water from the land treatment areas receiving wastewater at that rate will increase the average annual flow in some tributaries of the Vermilion, Huron, and Sandusky Rivers by as much as ten-fold, thus increasing the transport of sediment to Lake Erie and damaging aquatic habitat in the streams.

The existence of the winter storage basin located at the land treatment area provides a unique opportunity for the development of

industrial parks near this extensive source of cooling water and possibly process water. The cooling capacity of the basin is sufficient for its use by thermal power generating facilities, and the deep tunnel in combination with the storage basin provides potential pump-storage power production.

The application of treated wastewater to the land continuously supplies nutrients to the crops and should increase crop production and decrease fertilizer costs.

Within the Watershed the dispersed land treatment areas offer the unique opportunity of perservation of wildlife habitat and open space against urban sprawl.

These alternatives significantly reduce the flow in the Lower Cuyahoga River and diminish the potential inherent in other alternatives to enhance aquatic life and recreation in that river section.

Alternative 12

The pure land treatment alternative, Alternative 12, provides environmental benefits similar to those demonstrated by Alternatives 2 and 4. In addition, the treatment of wastewater from Akron by the overland flow/infiltration process provides direct recycle of renovated water to the Akron water supply and provides the potential for enhanced aquatic life and recreation in the Lower Cuyahoga River. Moreover, chemical resource requirements are minimized by this alternative.

Those environmental factors associated with Alternatives 2 and 4 are applicable to this alternative as well. Furthermore, the introduction of the overland flow/infiltration process and the employment of aerated lagoons for secondary treatment introduce additional environmental and public concerns. The overland flow/infiltration process is planned for publicly owned open space areas and greenbelts. Therefore, urban sprawl would be restricted, but purchase of lands would be necessary. The purchase of these lands should be integrated into the Ohio Outdoor Recreation Plans and the National Park proposals for the Cuyahoga River Valley.

The multi-purpose use of overland flow/infiltration area for wastewater treatment, greenbelts and open space areas, recreation, and production of a harvested crop to remove nutrients presents serious environmental questions. First, overland flow precludes recreation. Furthermore, the production of Reed Canary Grass, which is necessary to adequately extract the nutrients from the wastewater, will seriously restrict recreation potential. Finally, the institution owning and maintaining these areas must harvest and put the Reed Canary Grass to a useful purpose.

Various informed publics were more skeptical of the application of up to 150 inches per year of stormwater and 90 inches of wastewater to soils having lower infiltration capacity than for those soils to which

only 60 to 75 inches are applied.

The aerated lagoons provide the potential for occasional odors and groundwater contamination from bottom leaching. These problems can be minimized through adequate design, operation, and maintenance. If necessary, the lagoons can be sealed by an impervious barrier.

The use of aerated lagoons in Northcentral Ohio to replace the secondary treatment plants in Cleveland requires the transport of raw sewage through the deep tunnel. This action presents a potential public health hazard in the event of a failure of the transmission facility, resulting in the discharge of raw sewage into the Rocky, Cuyahoga, and Chagrin Rivers and Lake Erie. Furthermore, the potential use of the tunnel for cooling water supply by power plants along its route is reduced by the transport of raw sewage.

Alternatives 6 and 8

Many of the disadvantages of Alternatives 2, 4, and 12 were avoided by the configuration of Alternatives 6 and 8. The replacement of the overland flow/infiltration process by an advanced biological facility at Akron precluded the disadvantages of that process, while providing adequate flow to the Lower Cuyahoga River.

The provision of secondary treatment plants within the Three

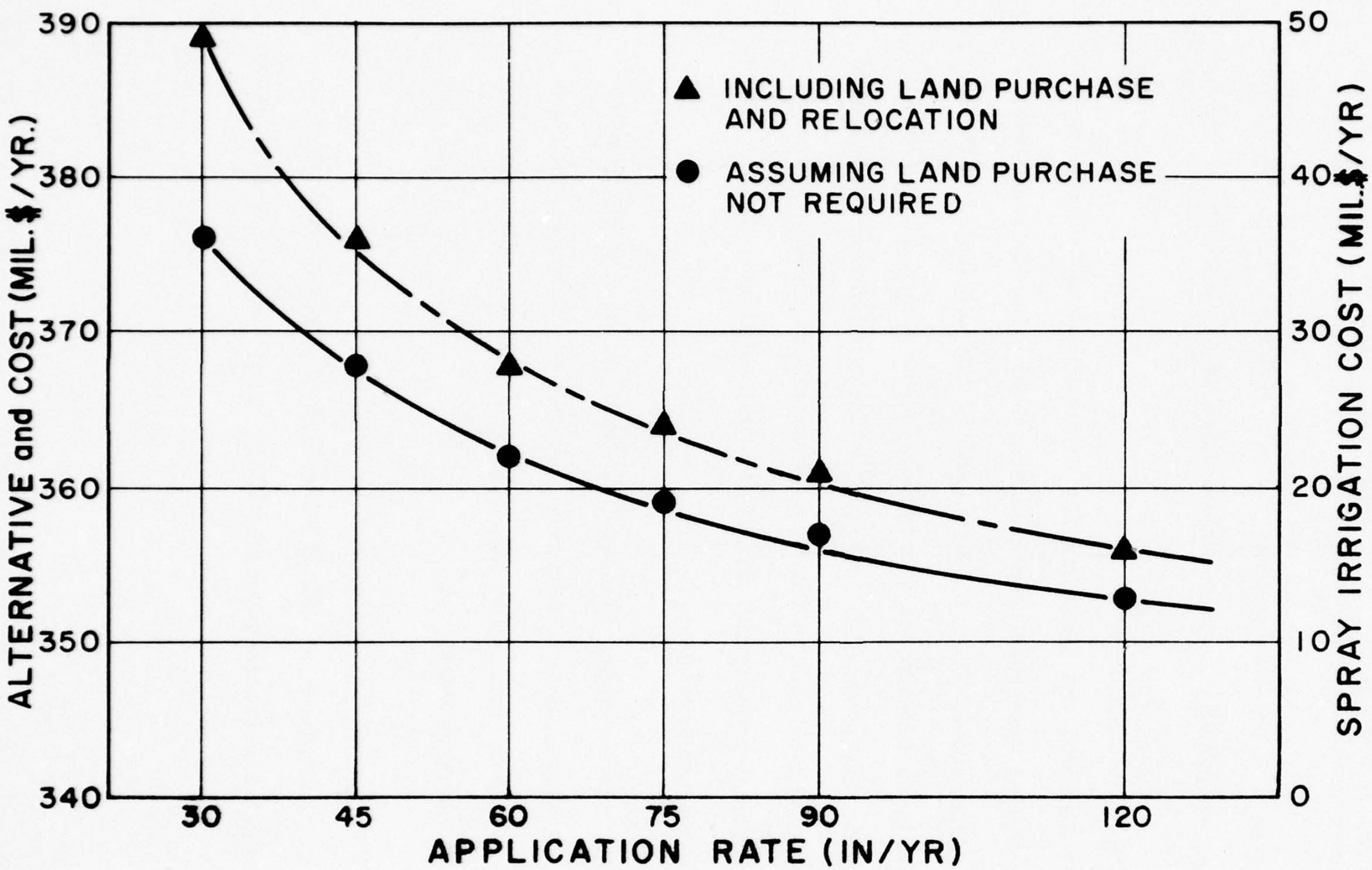
Rivers Watershed eliminated the concerns regarding aerated lagoons and transport of raw sewage in the deep tunnel.

Finally, the sensitivity of cost to rate of spray irrigation application in Northcentral Ohio and to purchase of those lands was performed. The results of that analysis for Alternative 8 are displayed in Figure 25. That figure demonstrates that if suitable agreements can be reached between farmers and wastewater treatment managers, thus eliminating the need for land purchase, the application rate can be reduced from 75 inches to 55 inches per year without affecting the total cost of the alternative. At the lower application rate, modifications in farm management may be reduced and possibly be unnecessary.

Some environmental and institutional problems remain unresolved by the configuration of Alternatives 6 and 8. They are: 1) the single large land treatment area in Northcentral Ohio, 2) increased discharge in the Northcentral Ohio rivers, and 3) the local opposition to the transport of wastewater from the metropolitan area to the rural environment.

<u>Alternative 9</u>

The cost of Alternative 9 demonstrates that no economic advantage was gained by the massive regionalization. Furthermore, the



LAND TREATMENT SENSITIVITY
ANALYSIS-ALTERNATIVE 8

FIGURE 25

extensive transmission pipelines inherent in this plan divert water from the rivers and prevent the reuse by downstream communities of treated wastewater that is presently returned at dispersed points along the streams.

These results substantiate the optimization of treatment plant siting identified in the Northeast Ohio Water Development Plan.

Alternatives 5 and 7

By limiting the configuration of Alternatives 5 and 7 to the Three Rivers Watershed, those insitutional problems associated with Alternatives 2, 4, 6, 8, 9, and 12 are eliminated. These alternatives provide for the recycle of nutrients by the land treatment technology in the upper portions of the Watershed, and thereby protect open space from urban sprawl. Winter storage of wastewater for treatment during the growing season results in low flow augmentation.

Alternative 7 provides an increment of water quality above that of Alternative 5 that increases the potential of the "Aquatic Life A" stream quality standard being met in the Navigation Channel of the Cuyahoga River.

F. Formulation Criteria for Refined Plans

The evaluation of the 12 alternatives demonstrated that the incremental increase in water quality provided by Level II above

that of Level I, can enhance the potential for aquatic life, recreation, and reuse, even in the Navigation Channel of the Cuyahoga River. However, the cost of providing that increment of quality is substantial, as Table 17 demonstrates. Since the 1985 objective in PL 92-500 is to eliminate the discharge of pollutants into waterways, refined plans are phased to achieve Level II by 1985.

The configuration of the refined plans are based on the environmental factors associated with the 12 alternatives. These factors include: 1) recycle of nutrients, 2) maintenance of adequate stream flow to preserve aquatic life, 3) providing open space and recreation potential, and 4) recycle of sludges for beneficial purposes.

Institutional considerations, including cooperative management of land treatment areas by farmers and wastewater treatment agencies and transport of wastewater from one region to another, are vitally important.

Finally, the public concerns over the cost, performance, and environmental and institutional factors must be resolved. Many of these concerns will be resolved as experience is gained with all technologies. Public Law 92-500 provides for the evolutionary development of systems to ultimately approach the 1985 objective.

As a result of this comprehensive analysis and the recommendations of the Ohio Environmental Protection Agency (See Attachment C), four plans were formulated in Phase 3 of this study. These plans are described in Chapter 7.

CHAPTER 7

THE FOUR SELECTED PLANS

A. Introduction

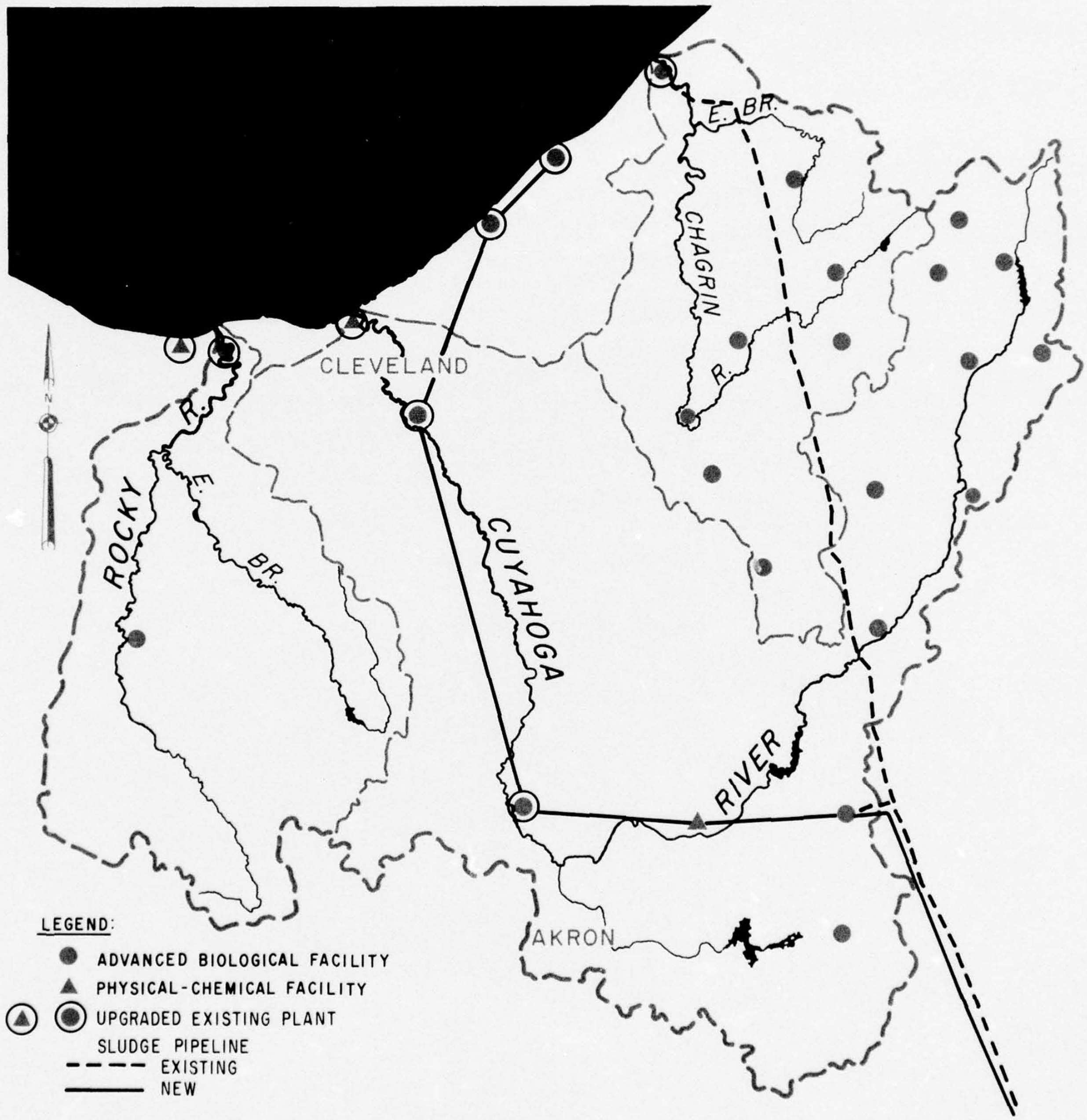
Three plans were selected for further formulation based upon the results of public meetings and preferences expressed by the State of Ohio about the 12 plans of Chapter 6. An additional plan has been selected to provide a comparison of costs and impacts for a lower level of treatment. Each of these four plans is developed in the same detail to permit relevant comparisons of these systems. The comparisons developed for these four plans provide the basis for selection by the State of Ohio and the various publics of an effective water quality management program. They should also assist the Federal EPA in its review and approval of proposed water quality standards.

Each plan represents a comprehensive Wastewater Management Program phased to meet the timing specified in Public Law 92-500, which is identified and quoted in Chapter 1 of this report. Each plan includes treatment of the three principal categories of wastewater: municipal, industrial, and urban stormwater runoff. Each plan provides treatment for the same total volumes of wastewater and runoff. Each plan is optimized for the specific treatment technologies included in its makeup. And finally, each plan emphasizes recycling and reuse inherent to the technological processes used and the geographic location of facilities.

B. Plan A to Level I

Plan A to Level I (A-I), displayed in Figure 26, duplicates the geographical layout of treatment facilities in the Three Rivers Watershed portion of the Northeast Ohio Water Development Plan for water quality control. The plan is regional, with a total of 26 proposed municipal plants, eight of which are now in existence. Municipal sewage is given biological treatment in all plants except Cleveland Westerly, Rocky River, and New Kent, where physical-chemical treatment is utilized (shown on Figure 26 as triangles). Table 19 tabulates the volumes of wastewater at the municipal/industrial treatment plants, and Table 20 describes treatment processes and construction phasing for each municipal plant. The construction is phased to meet current appropriate State of Ohio standards and Level I criteria for 1977 and 1983 as required by Public Law 92-500. After 1983, Plan A-I maintains that water quality merely enlarges facilities to accommodate increased flows.

Approximately 43 percent of stormwater runoff is treated in municipal plants during off-peak hours. The remaining 57 percent is treated in 81 separate advanced stormwater treatment plants. Urban stormwater volumes and proposed treatment methods are summarized in Table 21.



PLAN A-I AND A-II

FIGURE 26

TABLE 19

MUNICIPAL/INDUSTRIAL WASTEWATER TREATED BY DECADE

PLANS A-I and A-II

(MGD)

PLANT	1972	1980	1990	2000	2010	2020
Lake Erie						
Cleveland Easterly	125.00	140.00	148.00	158.00	164.00	172.00
Cleveland Westerly	35.91	37.14	39.69	41.22	42.75	45.18
Euclid	14.53	19.11	24.05	28.60	33.63	37.34
Rocky River	7.14	11.11	14.39	16.77	19.72	22.05
Total	182.58	207.36	226.13	244.59	260.10	276.57
Rocky River Basin						
Lakewood	17.11	18.00	19.00	19.00	20.00	21.00
Liverpool	3.08	6.69	9.40	12.24	15.85	20.09
Total	20.19	24.69	28.40	31.24	35.85	41.09
Cuyahoga River Basin						
Akron	71.00	84.09	97.83	111.33	129.03	149.67
Auburn Township	0.17	0.28	0.39	0.53	0.69	0.84
Burton	0.18	0.32	0.45	0.56	0.72	0.91
Butternut Creek	0.24	0.37	0.50	0.66	0.89	1.17
*Chardon	0.03	0.07	0.10	0.13	0.17	0.20
Cleveland Southerly	101.65	129.24	182.52	206.15	225.21	234.20
East Claridon	0.08	0.14	0.21	0.31	0.39	0.48
Kent	5.83	10.68	15.93	20.15	24.65	28.41
Mantua	0.29	0.37	0.47	0.58	0.74	0.86
Middlefield	0.77	1.06	1.42	1.72	2.23	2.70
Randolph	0.20	0.30	0.40	0.50	0.65	0.75
Ravenna	2.05	3.35	5.41	8.53	10.60	12.34
Troy Township	0.09	0.15	0.21	0.29	0.38	0.47
Total	182.58	230.42	305.84	351.44	396.35	433.00
Chagrin River Basin						
Aurora Central	0.22	0.60	1.32	1.73	2.31	2.98
Chagrin E. Branch	0.49	0.72	1.00	1.25	1.58	1.95
Chagrin Fall	0.81	1.35	2.05	2.53	3.08	3.58
Fairmount Road	0.07	0.54	1.55	2.14	2.80	3.40
Fowler's Mill	0.42	0.64	0.88	1.14	1.54	1.98
McFarland Creek	0.18	0.63	1.90	2.66	3.52	4.29
Newbury Township	0.33	0.50	0.69	0.90	1.13	1.54
Willoughby-Eastlake	5.55	7.92	11.61	15.07	18.96	22.27
Total	8.07	12.90	21.00	27.42	34.92	41.99
Interim Plants	20.10	21.21				
Grand Total	413.52	496.58	581.37	654.69	727.22	792.65

* Chardon is treated out of the Study Area and is not costed in this plan.

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TABLE 20

MUNICIPAL/INDUSTRIAL TREATMENT FACILITIES

PLAN A-I

	1972 – 1977 – 1980	1980 – 1985 – 2020
Lake Erie Basin		
Cleveland Easterly Euclid	Existing biological treatment plants are upgraded to meet Level 1 standards.	Treatment Plants are expanded as necessary.
Cleveland Westerly	Existing physical-chemical treatment plant is upgraded to meet Level 1 and 2 standards.	Treatment plant is expanded as necessary.
Rocky River	Physical-chemical component is added to the existing biological treatment plant to meet Level 1 standards.	Treatment plant is expanded as necessary.
Rocky River Basin		
Lakewood	Existing biological treatment plant is upgraded to meet Level 1 standards.	Treatment plant is expanded as necessary.
Liverpool	New advanced biological treatment plant is constructed to meet Level 1 standards.	Treatment plant is expanded as necessary.
Cuyahoga River Basin		
Akron Cleveland Southerly Ravenna	Existing biological treatment plants are upgraded to meet Level 1 standards.	Treatment plants are expanded as necessary.
New Kent	New physical-chemical treatment plant is constructed to meet Level 1 standards.	Treatment plant is expanded as necessary.
Auburn Township Burton Butternut Creek East Claridon Mantua Middlefield Randolph Troy Township	New advanced biological treatment plants are constructed to meet Level 1 standards and to satisfy secondary treatment requirement by 1977.	Treatment plants are expanded as necessary.
Chardon	A pumping plant and force main are constructed to transmit the sewage to a treatment plant outside the Study Area.	
Chagrin River Basin		
Aurora Central Chagrin East Branch Chagrin Falls Fairmount Road Fowler's Mill McFarland Creek Newbury Township	New advanced biological treatment plants are constructed to meet Level 1 standards.	Treatment plants are expanded as necessary.
Willoughby-Eastlake	Existing biological treatment plant is upgraded to meet Level 1 standards.	Treatment plant is expanded as necessary.

TABLE 21
PLANS A-I and A-II
URBAN STORMWATER RUNOFF
AVERAGE ANNUAL VOLUMES TO BE TREATED
(Millions of Gallons per Year - MG/Year)

Type of Treatment Facility	1980	1990	2000	2010	2020
Stormwater Treatment Plant	8,422	27,302	34,700	38,428	41,260
Municipal Sewage Treatment Plant	6,976	22,848	25,871	28,448	29,997
TOTAL	15,398	50,150	60,571	66,876	71,257

Sludge generated by wastewater and storm runoff treatment will be disposed of by several methods. Until 1990, the larger plants will either incinerate sludge or apply sludge to agricultural land. After 1990, some incineration will continue and two pipelines will convey sludge either to agricultural or stripmined land. Sludge from the smaller plants will be trucked to adjacent agricultural land. Sludge volumes generated by municipal/industrial wastewater are given in Table 22. Sludge disposal is described in Table 23, and illustrated in Figure 27.

C. Plan A to Level II

Plan A to Level II (A-II), displayed in Figure 26, duplicates the geographical layout of Plan A-I. This regional plan has the same 26 proposed municipal plants, eight of which are now in existence. Municipal sewage is given advanced biological treatment in all plants except Cleveland Westerly, Rocky River, and

TABLE 22

SLUDGE VOLUMES FOR DISPOSAL (Dry Tons Per Day) — PLAN A-I

PLANT	1972	1980	1990	2000	2010	2020
Lake Erie						
Cleveland Easterly	84.80	94.98	100.40	107.19	111.26	116.68
Cleveland Westerly	30.88	31.94	34.13	35.45	36.76	38.85
Euclid	9.86	12.96	16.32	19.40	22.81	25.33
Rocky River	3.20	4.98	6.45	7.51	8.83	9.88
Total	128.74	144.86	157.30	169.55	179.66	190.74
Rocky River Basin						
Lakewood	11.61	12.21	12.89	12.89	13.57	14.25
Liverpool	2.09	4.54	6.38	8.30	10.75	13.64
Total	13.70	16.75	19.27	21.19	24.32	27.89
Cuyahoga River Basin						
Akron	48.17	57.05	66.37	75.53	87.53	101.54
Auburn Township	0.12	0.19	0.26	0.36	0.47	0.57
Burton	0.12	0.22	0.30	0.38	0.49	0.62
Butternut Creek	0.16	0.25	0.34	0.45	0.60	0.79
Cleveland Southerly	68.69	87.68	123.82	139.85	152.78	158.88
East Claridon	0.05	0.09	0.14	0.21	0.26	0.33
Mantua	0.19	0.25	0.32	0.39	0.50	0.58
Middlefield	0.52	0.72	0.96	1.17	1.51	1.83
New Kent	5.01	9.18	13.70	17.33	21.20	24.43
Randolph	0.14	0.20	0.27	0.34	0.44	0.51
Ravenna	1.39	2.27	3.67	5.79	7.19	8.37
Troy Township	0.06	0.10	0.14	0.20	0.26	0.32
Total	124.89	158.20	210.29	242.00	273.23	298.77
Chagrin River Basin						
Aurora Central	0.15	0.41	0.90	1.17	1.57	2.02
Chagrin E. Branch	0.33	0.49	0.68	0.85	1.07	1.32
Chagrin Falls	0.55	0.91	1.39	1.71	2.09	2.43
Fairmount Road	0.05	0.37	1.05	1.45	1.90	2.31
Fowler's Mill	0.28	0.43	0.93	1.21	1.63	2.10
McFarland Creek	0.12	0.43	1.29	1.80	2.39	2.91
Newbury Township	0.22	0.34	0.47	0.61	0.77	1.04
Willoughby-Eastlake	2.29	5.37	7.87	10.22	12.86	15.11
Total	3.99	8.75	14.58	19.02	24.28	29.24
Grand Total	271.33	328.56	401.44	451.76	501.49	546.64

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TABLE 23

Plans A-I and A-II

SLUDGE DISPOSAL

	1972–1977	1977–1990	1990–2010
Lake Erie			
Cleveland Easterly	Sludge will be piped to Cleveland Southerly for incineration.		Sludge will be sent via new pipeline to strip-mined land.
Cleveland Westerly	Sludge will be incinerated.		
Euclid	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge will be sent via new pipeline to strip-mined land.
Rocky River (primary)	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.
Rocky River Basin			
Lakewood	Sludge will be flash dried and will be trucked to agricultural land.		Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.
Liverpool	Sludge handling from existing facilities will be phased out by 1977.	Sludge will be sent via pipeline to agricultural land.	
Cuyahoga River Basin*			
Akron	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge will be sent via new pipeline to strip-mined land.
Cleveland Southerly	Sludge will be incinerated.		
Ravenna	Sludge will be sent via the existing pipeline to strip-mined land.		
New Kent	Sludge will be incinerated.		
Auburn Township Burton Butternut Creek Mantua Middlefield Randolph	Sludge handling from existing facilities will be phased out by 1977.	Liquid sludge will be trucked to adjacent agricultural land.	
East Claridon Troy Township	Sludge handling from existing facilities will be phased out by 1977.	Sludge will be dried in sand drying beds and will be trucked to adjacent agricultural land.	
Chagrin River Basin			
Aurora Central Chagrin E. Branch Chagrin Falls Fairmount Road Fowler's Mill McFarland Creek Newbury Township	Sludge handling from existing facilities will be phased out by 1977.	Liquid sludge will be trucked to adjacent agricultural land.	
Willoughby-Eastlake	Sludge will be sent via the existing pipeline to strip-mined land.		Sludge will be sent via pipeline to agricultural land.

*No sludge disposal from Chardon.

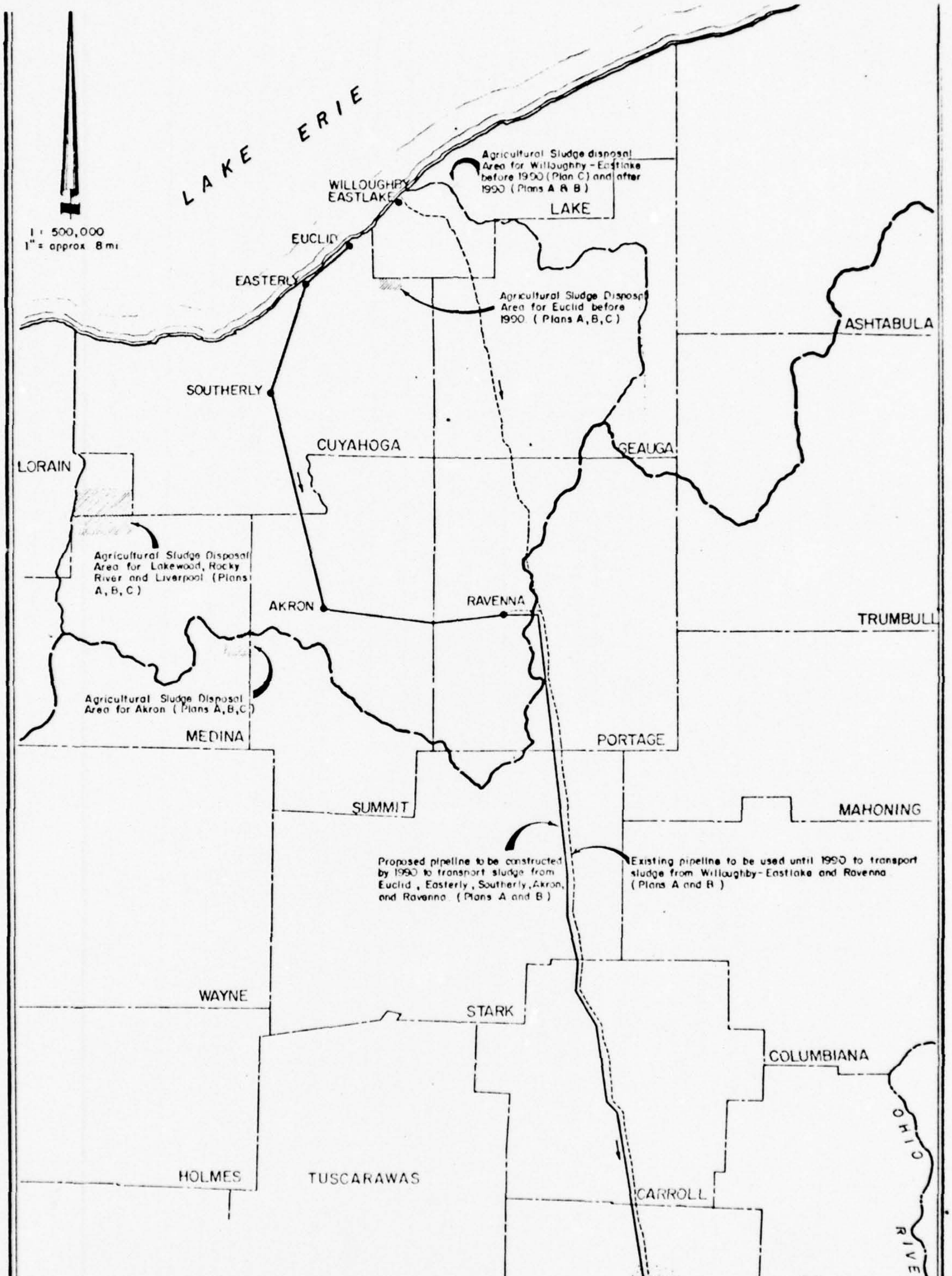

Figure 27

MAJOR SLUDGE DISPOSAL AREAS
WASTEWATER MANAGEMENT
SURVEY SCOPE STUDY

New Kent, where physical-chemical treatment is utilized (shown on Figure 26 as triangles). Table 19 tabulates the volumes of wastewater at the municipal/industrial treatment plants, and Table 24 describes the treatment facilities and construction phasing for municipal plants. The construction is phased to meet appropriate State of Ohio standards and Level I and II criteria for 1977, 1983, and 1985 as required by Public Law 92-500.

Approximately 43 percent of stormwater runoff is treated in municipal plants during off-peak hours. The remaining 57 percent is treated in 81 separate advanced stormwater treatment plants. Urban stormwater volumes and proposed treatment methods are summarized in Table 21.

Sludge generated by wastewater and storm runoff treatment will be disposed of by several methods. Until 1990, the larger plants will either incinerate sludge or apply sludge to agricultural land. After 1990, some incineration will continue and two pipelines will convey sludge either to agricultural or stripmined land. Sludge from the smaller plants will be trucked to adjacent agricultural land. Sludge volumes generated by municipal/industrial wastewater are given in Table 25. Sludge disposal is described in Table 26, and illustrated in Figure 27.

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TABLE 24

MUNICIPAL/INDUSTRIAL TREATMENT FACILITIES

PLAN A-II

	1972	1977	1980	1985	2020
Lake Erie Basin					
Cleveland Easterly Euclid	Existing biological treatment plants are upgraded to meet Level 1 standards.		Advanced biological treatment plants are upgraded to meet Level 2 standards.	Treatment plants are expanded as necessary.	
Cleveland Westerly	Existing physical-chemical treatment plant is upgraded to meet Level 1 and 2 standards.		Treatment plant is expanded as necessary.		
Rocky River	Physical-chemical component is added to the existing biological treatment plant to meet Level 1 standards.		Physical-chemical treatment component is upgraded to meet Level 2 standards.	Treatment plant is expanded as necessary.	
Rocky River Basin					
Lakewood	Existing biological treatment plant is upgraded to meet Level 1 standards.		Advanced biological treatment plant is upgraded to meet Level 2 standards.	Treatment plant is expanded as necessary.	
Liverpool	New advanced biological treatment plant is constructed to meet Level 1 standards.	Treatment plant is upgraded to meet Level 2 standards.		Treatment plant is expanded as necessary.	
Cuyahoga River Basin					
Akron Cleveland Southerly Ravenna	Existing biological treatment plants are upgraded to meet Level 1 standards.		Advanced biological treatment plants are upgraded to meet Level 2 standards.	Treatment plants are expanded as necessary.	
New Kent	New physical-chemical treatment plant is constructed to meet Level 1 standards.	Treatment plant is upgraded to meet Level 2 standards.		Treatment plant is expanded as necessary.	
Auburn Township Burton Butternut Creek East Claridon Mantua Middlefield Randolph Troy Township	New advanced biological treatment plants are constructed to meet Level 1 standards and to satisfy secondary treatment requirement by 1977.	Treatment plants are upgraded to meet Level 2 standards.		Treatment plants are expanded as necessary.	
Chardon	A pumping plant and force main are constructed to transmit the sewage to a treatment plant outside the Study Area.				
Chagrin River Basin					
Aurora Central Chagrin East Branch Chagrin Falls Fairmount Road Fowler's Mill McFarland Creek Newbury Township	New advanced biological treatment plants are constructed to meet Level 1 standards.	Treatment plants are upgraded to meet Level 2 standards.		Treatment plants are expanded as necessary.	
Willoughby-Eastlake	Existing biological treatment plant is upgraded to meet Level 1 standards.		Advanced biological treatment plant is upgraded to meet Level 2 standards.	Treatment plant is expanded as necessary.	

D. Plan B

Plan B combines the technologies of advanced biological, physical-chemical, and land treatment to achieve Level II criteria. A significant aspect of this plan is that, as in both levels of Plan A, all features are within the Three Rivers Watershed Area.

Plan B is similar to Plan A-I in that nine large municipal plants are common to both plans. These include Cleveland Southerly, Akron, New Kent, and six plants located on or near the Lake Erie shoreline. As in Plan A-II, Cleveland Westerly, Rocky River, and New Kent are physical-chemical plants; the remainder are advanced biological plants. All other wastewater treatment facilities located in the upper reaches of the Three Rivers are aerated lagoon/land treatment facilities. Figure 28 illustrates the plan. The plan study showed that, when considering land treatment, it was more cost effective to utilize aerated lagoons for secondary treatment than to expand the existing activated sludge plants for secondary treatment. The option is still open to local communities, however, to use their secondary treatment plants to the end of their useful life and move to aerated lagoons only as expansions and plant wear-outs require. There is also the option to expand existing activated sludge plants for secondary treatment and use land application only for advanced treatment. These options add cost to those shown in Table 39 for Plan B. A tabulation

TABLE 25

SLUDGE VOLUMES FOR DISPOSAL

PLAN A -II

(Dry Tons Per Day - DT/Day)

PLANT	1972	1980	1990	2000	2010	2020
Lake Erie						
Cleveland Easterly	84.80	94.98	107.98	115.28	119.65	125.49
Cleveland Westerly	30.88	31.94	34.13	35.45	36.76	38.85
Euclid	9.86	12.96	17.55	20.87	24.54	27.24
Rocky River	3.20	4.98	6.45	7.51	8.83	9.88
Total	128.74	144.86	166.11	179.11	189.78	201.46
Rocky River Basin						
Lakewood	11.61	12.21	13.86	13.86	14.59	15.32
Liverpool	2.09	4.54	6.86	8.93	11.56	14.66
Total	13.70	16.75	20.72	22.79	26.15	29.98
Cuyahoga River Basin						
Akron	48.17	57.05	71.38	81.23	94.14	109.20
Auburn Township	0.12	0.19	0.28	0.39	0.50	0.61
Burton	0.12	0.22	0.33	0.41	0.53	0.67
Butternut Creek	0.16	0.25	0.36	0.48	0.65	0.85
Cleveland Southerly	68.96	87.68	133.17	150.41	164.31	170.87
East Claridon	0.05	0.09	0.15	0.23	0.28	0.35
Mantua	0.20	0.25	0.34	0.42	0.54	0.63
Middlefield	0.52	0.72	1.04	1.25	1.63	1.97
New Kent	5.01	9.18	13.70	17.33	21.20	24.43
Randolph	0.14	0.20	0.29	0.36	0.47	0.55
Ravenna	1.39	2.27	3.95	6.22	7.73	9.00
Troy Township	0.06	0.10	0.15	0.21	0.28	0.34
*Total	124.90	158.20	225.14	258.94	292.26	319.47
Chagrin River Basin						
Aurora Central	0.15	0.41	0.96	1.26	1.69	2.17
Chagrin E. Branch	0.33	0.49	0.73	0.91	1.15	1.42
Chagrin Falls	0.55	0.91	1.49	1.84	2.25	2.61
Fairmount Road	0.05	0.37	1.13	1.56	2.04	2.48
Fowler's Mill	0.28	0.43	0.64	0.83	1.12	1.44
McFarland Creek	0.12	0.43	1.39	1.94	2.57	3.13
Newbury Township	0.22	0.34	0.50	0.66	0.82	1.12
Willoughby-Eastlake	2.29	5.37	8.47	11.00	13.83	16.25
Total	3.99	8.75	15.31	20.00	25.47	30.62
Grand Total	271.33	328.56	427.28	480.84	533.66	581.53

*No sludge is generated by Chardon within the Study Area.

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TABLE 26

SLUDGE DISPOSAL

PLAN A - II

	1972	1977	1990	2020
Lake Erie				
Cleveland Easterly	Sludge will be piped to Cleveland Southerly for incineration.		Sludge will be sent via new pipeline to strip-mined land.	
Cleveland Westerly	Sludge will be incinerated.			
Euclid	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge will be sent via new pipeline to strip-mined land.	
Rocky River (primary)	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.	
Rocky River Basin				
Lakewood	Sludge will be flash dried and will be trucked to agricultural land.		Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.	
Liverpool	Sludge handling from existing facilities will be phased out by 1977.	Sludge will be sent via pipeline to agricultural land.		
Cuyahoga River Basin*				
Akron	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge will be sent via new pipeline to strip-mined land.	
Cleveland Southerly	Sludge will be incinerated.		Sludge will be sent via new pipeline to strip-mined land.	
Ravenna	Sludge will be sent via the existing pipeline to strip-mined land.		Sludge will be sent via new pipeline to strip-mined land.	
New Kent	Sludge will be incinerated.			
Auburn Township Burton Butternut Creek Mantua Middlefield Randolph	Sludge handling from existing facilities will be phased out by 1977.	Liquid sludge will be trucked to adjacent agricultural land.		
East Claridon Troy Township	Sludge handling from existing facilities will be phased out by 1977.	Sludge will be dried in sand drying beds and will be trucked to adjacent agricultural land.		
Chagrin River Basin				
Aurora Central Chagrin E. Branch Chagrin Falls Fairmount Road Fowler's Mill McFarland Creek Newbury Township	Sludge handling from existing facilities will be phased out by 1977.	Liquid sludge will be trucked to adjacent agricultural land.		
Willoughby-Eastlake	Sludge will be sent via the existing pipeline to strip-mined land.		Sludge will be sent via pipeline to agricultural land.	

*No disposal from Chardon.

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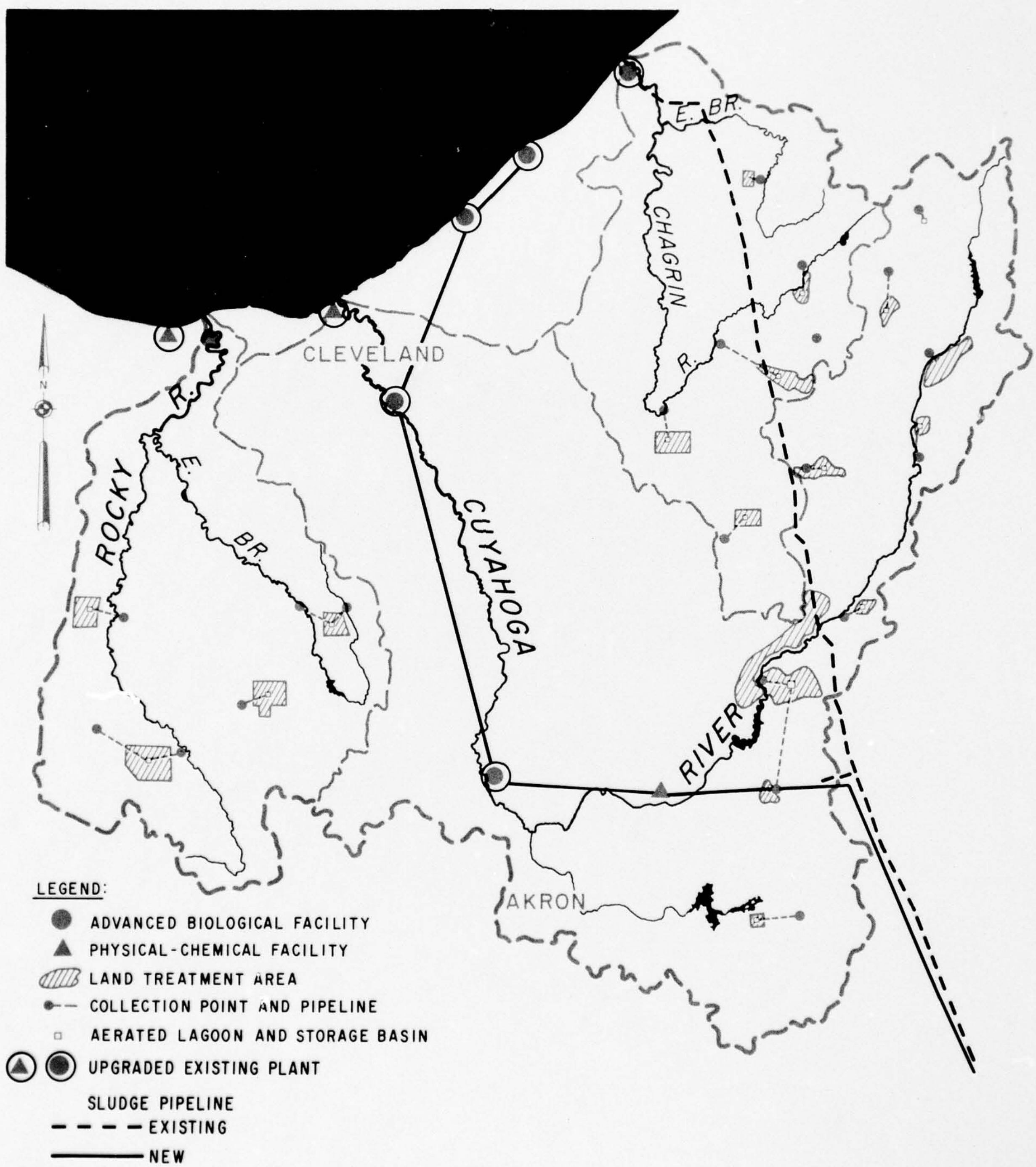

PLAN B

FIGURE 28

of the municipal plants with the volumes of municipal/industrial wastewater treated, is presented in Table 27. Table 28 shows the treatment processes involved and the phasing of construction. Construction phasing of the facilities provides for meeting Level I and Level II criteria specified for 1977, 1983, and 1985 as required by Public Law 92-500.

Wastewater treatment facilities in Plan B include six municipal advanced biological and three physical-chemical treatment plants, 22 municipal aerated-lagoon/land treatment systems, 39 advanced stormwater treatment plants, and 46 separate stormwater land treatment sites. By 2020, approximately 42 percent of the projected annual volume of stormwater to be treated is routed to advanced stormwater treatment plants, 44 percent to municipal aerated lagoons, and 14 percent to separate land treatment sites. Urban stormwater runoff treatment is summarized in Table 29 for Plan B.

TABLE 27

PLAN B

MUNICIPAL/INDUSTRIAL WASTEWATER TREATED BY DECADE

(MGD)

PLANT	1972	1980	1990	2000	2010	2020
Lake Erie						
Cleveland Easterly	125.00	140.00	148.00	158.00	164.00	172.00
Cleveland Westerly	35.91	37.14	39.69	41.22	42.75	45.18
Euclid	14.53	19.11	24.05	28.60	33.63	37.34
Rocky River	7.14	11.11	14.39	16.77	19.72	22.05
Total	182.58	207.36	226.13	244.59	260.10	276.57
Rocky River Basin						
Hinckley	0.12	0.55	1.04	1.25	1.50	1.72
Lakewood	17.11	18.00	19.00	19.00	20.00	21.00
Liverpool	0.41	1.31	1.96	2.57	3.41	5.00
Mallet Creek	0.10	0.20	0.30	0.40	0.50	0.60
Medina County	0.41	1.31	1.96	2.57	3.41	5.00
New Medina	2.16	3.87	5.18	6.70	8.53	9.49
Upper East Branch	0.08	0.36	0.68	0.81	0.96	1.11
Total	20.39	25.60	30.12	33.30	38.31	43.92
Cuyahoga River Basin						
Akron	71.00	84.09	97.83	111.33	129.03	149.67
Auburn Township	0.17	0.28	0.39	0.53	0.69	0.84
Burton	0.95	1.38	1.87	2.28	2.95	3.61
Butternut Creek	0.24	0.37	0.50	0.66	0.89	1.17
Chardon	0.03	0.07	0.10	0.13	0.17	0.20
Cleveland Southerly	101.65	128.33	179.68	202.67	221.02	229.37
East Claridon	0.08	0.14	0.21	0.31	0.39	0.48
Mantua	0.29	0.37	0.47	0.58	0.74	0.86
New Kent	5.83	10.68	15.93	20.15	24.65	28.41
Randolph	0.20	0.30	0.40	0.50	0.65	0.75
Ravenna	2.05	3.35	5.41	8.53	10.60	12.34
Shalersboro	0.59	0.84	1.12	1.42	1.73	2.00
Troy Township	0.09	0.15	0.21	0.29	0.38	0.47
Total	183.17	230.35	304.12	349.38	393.89	430.17
Chagrin River Basin						
Aurora Central	0.22	0.60	1.32	1.73	2.31	2.98
Chagrin E. Branch	0.49	0.72	1.00	1.25	1.58	1.95
Chagrin Falls	0.99	1.98	3.95	5.19	6.60	7.87
Fairmount Road	0.07	0.54	1.55	2.14	2.80	3.40
Fowler's Mill	0.42	0.64	0.88	1.14	1.54	1.98
Newbury Township	0.33	0.50	0.69	0.90	1.13	1.54
Willoughby-Eastlake	5.55	7.92	11.61	15.07	18.96	22.27
Total	8.07	12.90	21.00	27.42	34.92	41.99
Interim Plants	19.31	20.37				
Grand Total	413.52	496.58	581.37	654.69	727.22	792.65

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TABLE 28

MUNICIPAL/INDUSTRIAL TREATMENT FACILITIES

PLAN 3

	1972	1977	1980	1983	1985–2020
Lake Erie Basin					
Cleveland Easterly Euclid	Existing biological treatment plants are upgraded to meet Level 1 standards.		Advanced biological treatment plants are upgraded to meet Level 2 standards.		Treatment plants are expanded as necessary.
Cleveland Westerly	Existing physical-chemical treatment plant is upgraded to meet Level 1 and 2 standards.		Treatment plant is expanded as necessary.		
Rocky River	Physical-chemical component is added to the existing biological treatment plant to meet Level 1 standards.		Physical-chemical treatment component is upgraded to meet Level 2 standards.		Treatment plant is expanded as necessary.
Rocky River Basin					
Lakewood	Existing biological treatment plant is upgraded to meet Level 1 standards.		Advanced biological treatment plant is upgraded to meet Level 2 standards.		Treatment plant is expanded as necessary.
Hinckley Liverpool Mallet Creek Medina County New Medina Upper East Branch	Existing treatment facilities are phased out and aerated lagoons are constructed by 1977 to satisfy secondary treatment requirements.	Aerated lagoons are operated to provide secondary treatment. Winter reservoirs and land treatment sites are constructed by 1983 to meet Level 2 standards.		Land treatment facilities are expanded as necessary.	
Cuyahoga River Basin					
Akron Cleveland Southerly	Existing biological treatment plants are upgraded to meet Level 1 standards.		Advanced biological treatment plants are upgraded to meet Level 2 standards.		Treatment plants are expanded as necessary.
New Kent	New physical-chemical treatment plant is constructed to meet Level 1 standards.	Treatment plant is upgraded to meet Level 2 standards.			Treatment plant is expanded as necessary.
Auburn Township Burton Butternut Creek Chardon East Claridon Mantua Randolph Ravenna Shalersboro Troy Township	Existing treatment facilities are phased out and aerated lagoons are constructed by 1977 to satisfy secondary treatment requirements.	Aerated lagoons are operated to provide secondary treatment. Winter reservoirs and land treatment sites are constructed by 1983 to meet Level 2 standards.		Land treatment facilities are expanded as necessary.	
Chagrin River Basin					
Aurora Central Chagrin E. Branch Chagrin Falls Fairmount Road Fowler's Mill Newbury Township	Existing treatment facilities are phased out and aerated lagoons are constructed by 1977 to satisfy secondary treatment requirements.	Aerated lagoons are operated to provide secondary treatment. Winter reservoirs and land treatment sites are constructed by 1983 to meet Level 2 standards.		Land treatment facilities are expanded as necessary.	
Willoughby-Eastlake	Existing biological treatment plant is upgraded to meet Level 1 standards.		Advanced biological treatment plant is upgraded to meet Level 2 standards.		Treatment plant is expanded as necessary.

TABLE 29
PLAN B
URBAN STORMWATER RUNOFF
AVERAGE ANNUAL VOLUMES TO BE TREATED
(Millions of Gallons per Year - MG/Year)

Type of Treatment Facility	1980	1990	2000	2010	2020
Advanced Stormwater Treatment Plant	8,422	22,620	26,483	29,534	29,797
Municipal Sewage Treatment Plant	6,976	22,706	24,969	27,344	28,480
Separate Stormwater Land Treatment		3,550	7,018	8,477	9,956
Municipal Land Treatment Facility		1,274	2,101	2,521	3,024
TOTAL	15,398	50,150	60,571	67,876	71,257

Sludge disposal for Plan B is quite similar to both levels of Plan A, being accomplished by incineration or application to agricultural and stripmined land. An existing pipeline could transport sludge from Willoughby-Eastlake to stripmined disposal areas until 1990. After 1990, a new pipeline will convey sludge from Euclid, Cleveland Easterly, Cleveland Southerly, and Akron to stripmined land; a second pipeline will carry sludge from Willoughby-Eastlake to agricultural land. These pipelines and the disposal areas are indicated in Figure 27. Sludge volumes produced by municipal/industrial wastewater are given in Table 30. Sludge disposal is described in Table 31.

TABLE 30

SLUDGE VOLUMES FOR DISPOSAL PLAN B

(Dry Tons Per Day - DT/Day)

PLANT	1977	1980	1990	2000	2010	2020
Lake Erie						
Cleveland Easterly	91.93	94.98	107.98	115.28	119.65	125.49
Cleveland Westerly	31.62	31.94	34.13	35.45	36.76	38.85
Euclid	12.03	12.96	17.55	20.87	24.54	27.24
Rocky River	4.45	4.98	6.45	7.51	8.83	9.88
Total	140.03	144.86	166.11	179.11	189.78	201.46
Rocky River Basin						
Hinckley	0.09	0.12	0.20	0.26	0.32	0.36
Lakewood	12.03	12.21	13.86	13.86	14.59	15.32
Liverpool	0.22	0.28	0.41	0.54	0.72	1.05
Mallet Creek	0.04	0.04	0.06	0.08	0.11	0.13
Medina County	0.22	0.28	0.41	0.53	0.72	1.05
New Medina	0.51	0.61	0.85	1.10	1.44	1.99
Upper East Branch	0.06	0.08	0.14	0.17	0.20	0.23
Total	13.17	13.62	15.93	16.54	18.10	20.13
Cuyahoga River Basin						
Akron	54.39	57.05	71.38	81.23	94.14	109.20
Auburn Township	0.05	0.06	0.08	0.11	0.15	0.18
Burton	0.26	0.29	0.40	0.48	0.62	0.76
Butternut Creek	0.07	0.08	0.11	0.14	0.19	0.25
Chardon	--	0.01	0.02	0.03	0.04	0.04
Cleveland Southerly	81.63	87.06	131.09	147.87	161.26	167.35
East Claridon	0.03	0.03	0.04	0.07	0.08	0.10
Mantua	0.07	0.08	0.11	0.12	0.16	0.18
New Kent	7.93	9.18	13.70	17.33	21.20	24.43
Randolph	0.06	0.06	0.08	0.11	0.14	0.16
Ravenna	0.62	0.70	1.14	1.80	2.23	2.59
Shalersboro	0.16	0.18	0.24	0.30	0.36	0.42
Troy Township	--	0.03	0.04	0.06	0.08	0.10
Total	145.27	154.81	218.43	249.65	280.65	305.76
Chagrin River Basin						
Aurora Central	0.10	0.13	0.28	0.36	0.49	0.63
Chagrin E. Branch	0.14	0.15	0.21	0.26	0.33	0.41
Chagrin Falls	0.35	0.42	0.82	1.09	1.39	1.65
Fairmount Road	0.08	0.11	0.33	0.45	0.59	0.71
Fowler's Mill	0.12	0.13	0.19	0.24	0.32	0.42
Newbury Township	0.09	0.10	0.15	0.19	0.24	0.32
Willoughby-Eastlake	4.89	5.37	8.47	11.00	13.83	16.25
Total	5.77	6.41	10.45	13.59	17.19	20.39
Grand Total	304.24	319.70	410.92	458.89	505.72	547.74

PLAN B

TABLE 31

SLUDGE DISPOSAL

	1972 – 1977	1977 – 1990	1990 – 2020
Lake Erie			
Cleveland Easterly	Sludge will be piped to Cleveland Southerly for incineration.		Sludge will be sent via new pipeline to strip-mined land.
Cleveland Westerly	Sludge will be incinerated.		
Euclid	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge will be sent via new pipeline to strip-mined land.
Rocky River (primary)	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.
Rocky River Basin			
Lakewood	Sludge will be flash dried and will be trucked to agricultural land.		Sludge from Rocky River (primary) and Lakewood will be sent via pipeline to agricultural land.
Hinckley Liverpool Mallet Creek Medina County New Medina Upper East Branch	Sludge handling from existing facilities will be phased out by 1977.	Sludge removed from aerated lagoons will be piped to adjacent agricultural land.	
Cuyahoga River Basin			
Akron	Sludge will be vacuum-filtered and trucked to agricultural land.		Sludge will be sent via new pipeline to strip-mined land.
Cleveland Southerly	Sludge will be incinerated.		
New Kent	Sludge will be incinerated.		
Auburn Township Burton Butternut Creek Chardon East Claridon Mantua Randolph Ravenna Shalersboro Troy Township	Sludge handling from existing facilities will be phased out by 1977.	Sludge removed from aerated lagoons will be piped to adjacent agricultural land.	
Chagrin River Basin			
Aurora Central Chagrin E. Branch Chagrin Falls Fairmount Road Fowler's Mill Newbury Township	Sludge handling from existing facilities will be phased out by 1977.	Sludge removed from aerated lagoons will be piped to adjacent agricultural land.	
Willoughby-Eastlake	Sludge will be sent via the existing pipeline to strip-mined land.		Sludge will be sent via pipeline to agricultural land.

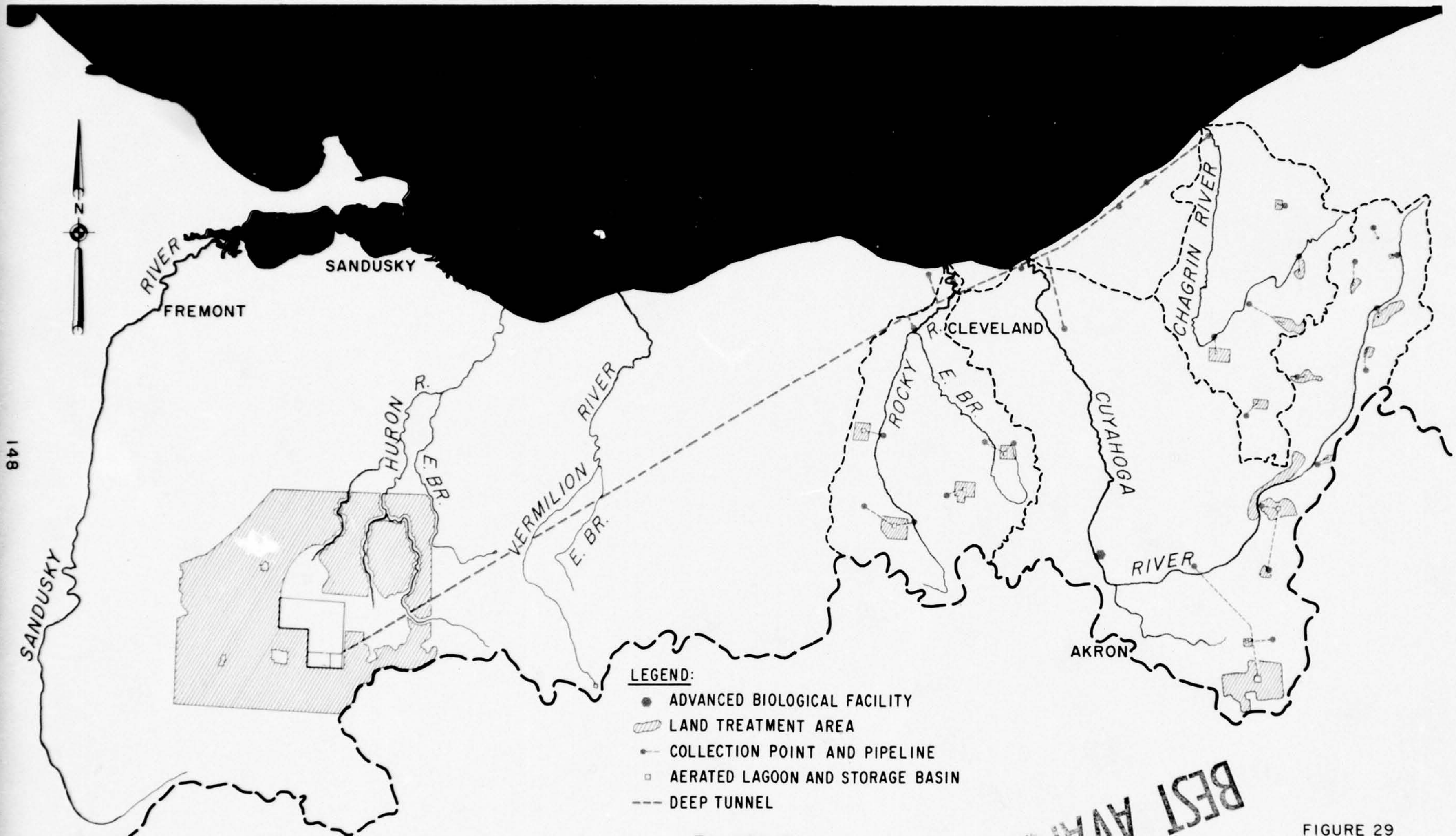
In Plan B, plant site selection was based upon the objective of providing land treatment where appropriate sites existed in reasonable proximity to the smaller plant locations within the Three Rivers Watershed Area. The larger advanced biological treatment plants would be sited in a manner identical to that in the Northeast Ohio Water Development Plan.

E. Plan C

Plan C, portrayed in Figure 29, provides an alternative to Plans A-II and B by providing for the transport of wastewater generated within the Three Rivers Watershed Area to a suitable land treatment area in Northcentral Ohio, as well as providing treatment within the Three Rivers Watershed.

Ultimately, 81 percent of the municipal/industrial and 74 percent of the urban stormwater runoff would be treated by the land treatment technology, with 69 percent of the municipal/industrial wastewater and 55 percent of the stormwater runoff being transported to a single land treatment site in Northcentral Ohio.

A transmission tunnel conveys wastewater and stormwater runoff from the Cleveland metropolitan area to the North Central Ohio agricultural area. The 183-square mile western land treatment site lies in portions of Huron, Seneca, Crawford, and Richland Counties and is illustrated in Figure 29. The Akron plant is the only advanced biological treatment plant. It discharges purified water



PLAN C

FIGURE 29

directly to the Cuyahoga River. This treatment plant will be expanded and modified to treat sewage to a level permitting body contact sports in the Cuyahoga River. The discharge from Akron will increase the flow of the Cuyahoga River during low flow periods. Streamflow will also be augmented by the upstream land treatment facilities that secondarily treat and store wastewater over the winter and apply the treated wastewater to the land during the summer when natural flows are at their lowest level and when municipal withdrawals create the most impact.

Of the stormwater not transported to Northcentral Ohio, 51 percent (23 percent of the total) is treated in advanced stormwater treatment plants, 6 percent (3 percent of the total) in combination with municipal wastewater in the Akron wastewater treatment plant, 12 percent (5 percent of the total) in combination with municipal wastewater at municipal land treatment facilities, and 31 percent (14 percent of the total) by separate stormwater land treatment. Table 32 summarizes the urban stormwater treatment.

TABLE 32
PLAN C
URBAN STORMWATER RUNOFF
AVERAGE ANNUAL VOLUMES TO BE TREATED
(Millions of Gallons per Year - MG/Year)

Type of Treatment Facility	1980	1990	2000	2010	2020
Advanced Stormwater Treatment Plant	1,642	10,575	13,738	15,013	16,230
Municipal Sewage Treatment Plant	13,756	1,241	1,546	1,856	2,014
Separate Stormwater Land Treatment		3,550	7,018	8,477	9,956
Municipal Land Treatment Facility		1,880	2,794	3,318	3,891
Transmission Tunnel Land Treatment	-----	32,904	35,475	38,212	39,166
TOTAL	15,398	50,150	60,571	66,876	71,257

Sludge disposal in Plan C will be accomplished primarily by incineration and application to agricultural land prior to 2000. By 2000, incineration will be phased out and sludge generated by the aerated lagoons will be placed on agricultural land. The sludge normally generated at the Lake Erie shoreline plants is removed at the Western Land Treatment Area in Plan C. There is no provision for sludge disposal in the stripmined land in southeast Ohio. Sludge volumes generated by this plan are identified in Table 33, and the disposal practices are identified in Table 34. Table 35 tabulates the volume of municipal/industrial wastewater treated in the plan by decade, and Table 36 identifies the types of treatment plants and the phasing of implementation.

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TABLE 33

SLUDGE VOLUMES FOR DISPOSAL PLAN C

(Dry Tons Per Day - DT/Day)

PLANT	1977	1980	1990	2000	2010	2020
Western Land Treatment Area	--	--	36.88	101.08	109.22	115.33
Lake Erie Shoreline Plants						
Euclid	12.04	12.96	--	--	--	--
Lakewood	12.03	12.21	--	--	--	--
North Olmsted	10.01	12.78	--	--	--	--
Rocky River	4.44	4.98	--	--	--	--
Willoughby-Eastlake	4.88	5.37	--	--	--	--
Easterly	91.93	94.98	60.62	--	--	--
Southerly	76.82	80.21	63.33	--	--	--
Westerly	31.62	31.94	34.13	--	--	--
Total	243.77	255.43	158.08	--	--	--
Rocky River Basin						
Hinckley	0.09	0.12	0.20	0.26	0.32	0.36
Liverpool	0.22	0.28	0.41	0.54	0.72	1.05
Mallet Creek	0.04	0.04	0.06	0.08	0.11	0.13
Medina County	0.22	0.28	0.41	0.53	0.72	1.05
New Medina	0.63	0.81	1.09	1.41	1.79	1.99
Upper East Branch	0.06	0.08	0.14	0.17	0.20	0.23
Total	1.26	1.61	2.31	2.99	3.86	4.81
Cuyahoga River Basin						
Akron	54.39	57.05	71.38	81.23	94.14	109.20
Auburn Township	0.05	0.06	0.08	0.11	0.15	0.18
Burton	0.26	0.29	0.40	0.48	0.62	0.76
Butternut Creek	0.07	0.08	0.11	0.14	0.19	0.25
Chardon	--	0.01	0.02	0.03	0.04	0.04
East Claridon	0.03	0.03	0.04	0.07	0.08	0.10
Mantua	0.07	0.08	0.11	0.12	0.16	0.18
New Kent	1.94	2.25	3.35	4.24	5.18	5.97
Randolph	0.06	0.06	0.08	0.11	0.14	0.16
Ravenna	0.62	0.70	1.14	1.80	2.23	2.59
Shalersboro	0.16	0.18	0.24	0.30	0.36	0.42
Troy Township	--	0.03	0.04	0.06	0.08	0.10
Total	57.65	60.82	76.99	88.69	103.37	119.95
Chagrin River Basin						
Aurora Central	0.10	0.13	0.28	0.36	0.49	0.63
Chagrin East Branch	0.14	0.15	0.21	0.26	0.33	0.41
Chagrin Falls	0.35	0.42	0.82	1.09	1.39	1.65
Fairmount Road	0.08	0.11	0.33	0.45	0.59	0.71
Fowler's Mill	0.12	0.13	0.19	0.24	0.32	0.42
Newbury Township	0.09	0.10	0.15	0.19	0.24	0.32
Total	0.88	1.04	1.98	2.59	3.36	4.14
Grand Total	303.56	318.90	276.24	195.35	219.81	244.23

TABLE 34

SLUDGE DISPOSAL

PLAN C

	1972	1977	1990	2000–2020
Western Land Treatment Area	No sludge disposal facilities will be required.		Sludge removed from aerated lagoon will be piped to adjacent agricultural land.	
Transmission Tunnel				
Euclid STP (Tunnel Inlet) North Olmsted STP (Tunnel Inlet) Rocky River STP (Tunnel Inlet) Willoughby-Eastlake STP (Tunnel Inlet)	Sludge will be vacuum-filtered and trucked to agricultural land.		All sludge will be removed at the Western Land Treatment Area.	
Lakewood STP (Tunnel Inlet)	Sludge will be flash dried and trucked to agricultural land.		All sludge will be removed at the Western Land Treatment Area.	
Easterly STP (Tunnel Inlet)	Sludge will be sent via pipeline to Cleveland Southerly for incineration.			All sludge will be removed at the Western Land Treatment Area.
Southerly STP (Tunnel Inlet) Westerly STP (Tunnel Inlet)	Sludge will be incinerated.			
Rocky River In-Basin				
Hinckley Liverpool Mallet Creek Medina County New Medina Upper East Branch	Sludge handling from existing facilities will be phased out by 1977.	Sludge removed from aerated lagoons will be piped to adjacent agricultural land.		
Cuyahoga River In-Basin				
Akron	Sludge will be sent by pipeline to agricultural land.			
Auburn Township Burton Butternut Creek Chardon East Claridon Mantua New Kent Randolph Ravenna Shalersboro Troy Township	Sludge handling from existing facilities will be phased out by 1977.	Sludge removed from aerated lagoons will be piped to adjacent agricultural land.		
Chagrin River In-Basin				
Aurora Central Chagrin East Branch Chagrin Falls Fairmount Road Fowler's Mill Newbury Township	Sludge handling from existing facilities will be phased out by 1977.	Sludge removed from aerated lagoons will be piped to adjacent agricultural land.		

TABLE 35

MUNICIPAL/INDUSTRIAL WASTEWATER TREATED BY DECADE

(MGD)

PLAN C

PLANT	1972	1980	1990	2000	2010	2020
Western Land Treatment Area			94.12	481.33	520.09	549.21
Transmission Tunnel						
Euclid	14.53	19.11	(24.05)	(28.60)	(33.63)	(37.34)
Lakewood	17.11	18.00	(19.00)	(19.00)	(20.00)	(21.00)
North Olmsted	5.24	18.84	(25.07)	(29.77)	(34.23)	(37.00)
Rocky River	7.14	11.11	(14.39)	(16.77)	(19.72)	(22.05)
Willoughby-Eastlake	5.55	7.92	(11.61)	(15.07)	(18.96)	(22.27)
Easterly	125.00	140.00	148.00	(158.00)	(164.00)	(172.00)
Southerly	101.65	118.23	154.61	(172.90)	(186.79)	(192.37)
Westerly	35.91	37.14	39.69	(41.22)	(42.75)	(45.18)
Total	312.13	370.36	342.30	(All flows to Western Land Treatment Area)		
Rocky River In-Basin						
Hinckley	0.12	0.55	1.04	1.25	1.50	1.72
Liverpool	0.41	1.31	1.96	2.57	3.41	5.00
Mallet Creek	0.10	0.20	0.30	0.40	0.50	0.60
Medina County	0.41	1.31	1.96	2.57	3.41	5.00
New Medina	2.16	3.87	5.18	6.70	8.53	9.49
Upper East Branch	0.08	0.36	0.68	0.81	0.96	1.11
Total	3.28	7.60	11.12	14.30	18.31	22.92
Cuyahoga River In-Basin						
Akron	71.00	84.09	97.83	111.33	129.03	149.67
Auburn Township	0.17	0.28	0.39	0.53	0.69	0.84
Burton	0.95	1.38	1.87	2.28	2.95	3.61
Butternut Creek	0.24	0.37	0.50	0.66	0.89	1.17
Chardon	0.03	0.07	0.10	0.13	0.17	0.20
East Claridon	0.08	0.14	0.21	0.31	0.39	0.48
Mantua	0.29	0.37	0.47	0.58	0.74	0.86
New Kent	5.83	10.68	15.93	20.15	24.65	28.41
Randolph	0.20	0.30	0.40	0.50	0.65	0.75
Ravenna	2.05	3.35	5.41	8.53	10.60	12.34
Shalersboro	0.59	0.84	1.12	1.42	1.73	2.00
Troy Township	0.09	0.15	0.21	0.29	0.38	0.47
Total	81.52	102.02	124.44	146.71	172.87	200.80
Chagrin In-Basin						
Aurora Central	0.22	0.60	1.32	1.73	2.31	2.98
Chagrin East Branch	0.49	0.72	1.00	1.25	1.58	1.95
Chagrin Falls	0.99	1.98	3.95	5.19	6.60	7.87
Fairmount Road	0.07	0.54	1.55	2.14	2.80	3.40
Fowler's Mill	0.42	0.64	0.88	1.14	1.54	1.98
Newbury Township	0.33	0.50	0.69	0.90	1.13	1.54
Total	2.52	4.98	9.39	12.35	15.96	19.72
Interim Plants	14.07	11.63				
Grand Total	413.52	496.58	581.37	654.69	727.22	792.65

TABLE 36

MUNICIPAL/INDUSTRIAL TREATMENT FACILITIES

PLAN C

	1972–1977	1977–1980	1980–1983	1983–1985	1985–1990	1990–2000	2000–2020
Western Land Treatment Area	Transmission tunnel, winter storage reservoir and land treatment site are constructed by 1985 to meet Level 2 standards.				Secondary effluent transported by the tunnel is provided storage and land treatment. The aerated lagoon is constructed by 1990.	Aerated lagoon and land application provide both secondary and final treatment at the Western Land Treatment Area.	
Transmission Tunnel							
Euclid STP (Tunnel Inlet) Lakewood STP (Tun Inlet) North Olmsted STP (Tunnel Inlet) Rocky River STP (Tunnel Inlet) Willoughby-Eastlake STP (Tunnel Inlet)	Existing treatment plants are upgraded to meet Level 1 standards. New construction and replacement of facilities are sized to be phased out in 1990.		Treatment plants provide Level 1 treatment and are expanded as necessary.		Treatment plants are downgraded to provide secondary treatment. Effluent is discharged to tunnel and receives land treatment to meet Level 2 standards.	Treatment plants are phased out in 1990 and only preliminary treatment is provided at tunnel inlets. Aerated lagoon and land application provide both secondary and final treatment at Western Land Treatment Area.	
Easterly STP (Tunnel Inlet) Southerly STP (Tunnel Inlet) Westerly STP (Tunnel Inlet)	Existing treatment plants are upgraded to meet Level 1 standards. New construction and replacement of facilities are sized to be phased out in 2000.		Treatment plants provide Level 1 treatment and are expanded as necessary.		Treatment plants are downgraded to provide secondary treatment. Effluent is discharged to tunnel and receives land treatment to meet Level 2 standards.	Period of redundancy with secondary treatment provided both at treatment plants and at aerated lagoon.	Treatment plants are phased out in 2000 and only preliminary treatment is provided at tunnel inlets. Aerated lagoon and land application provide both secondary and final treatment at Western Land Treatment Area.
Rocky River In-Basin							
Hinckley Liverpool Mallet Creek Medina County New Medina Upper East Branch	Existing treatment facilities are phased out and aerated lagoons are constructed by 1977 to satisfy secondary treatment requirements.	Aerated lagoons are operated to provide secondary treatment. Winter reservoirs and land treatment sites are constructed by 1983 to meet Level 2 standards.		Land treatment facilities are expanded as necessary.			
Cuyahoga River In-Basin							
Akron	Existing biological treatment plant is upgraded to meet Level 1 standards.		Advanced biological treatment plant is upgraded to meet Level 2 standards.		Treatment plant is expanded as necessary.		
Auburn Township Burton Butternut Creek Chardon East Claridon Mantua New Kent Randolph Ravenna Shalersboro Troy Township	Existing treatment facilities are phased out and aerated lagoons are constructed by 1977 to satisfy secondary treatment requirements.	Aerated lagoons are operated to provide secondary treatment. Winter reservoirs and land treatment sites are constructed by 1983 to meet Level 2 standards.		Land treatment facilities are expanded as necessary.			
Chagrin River In-Basin							
Aurora Central Chagrin E. Branch Chagrin Falls Fairmount Road Fowler's Mill Newbury Township	Existing treatment facilities are phased out and aerated lagoons are constructed by 1977 to satisfy secondary treatment	Aerated lagoons are operated to provide secondary treatment. Winter reservoirs and land treatment sites are constructed by 1983 to meet Level 2 standards.		Land treatment facilities are expanded as necessary.			

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Although Plan C represents a significant departure from traditional wastewater treatment practices, its phasing is programmed to recognize the current local planning and the early planning of the Northeast Ohio Water Development Plan. The evolution from the current treatment plant system to the ultimate Plan C configuration will not be culminated until the year 2000. As now envisioned, no land application of wastewater is necessary prior to 1983, as shown in Table 36. The decision as to whether the Northcentral Ohio land treatment area is chosen can be postponed until 1980. In this manner, full advantage can be taken of the accumulating scientific data from various research and demonstration projects throughout the nation.

F. Summary of Plan Impacts

In retaining Plans A-I, A-II, B, and C for possible future implementation, the maximum amount of flexibility has been retained. This flexibility allows future conditions to affect the evolution of the total system so that the system may be initiated as one plan and end as another or even change to be like none of the four.

The Level II plans are time-phased to meet the requirements of Public Law 92-500. They are also time-phased so as to expend money on those priorities as established in that law. Furthermore, phasing is programmed in accordance with the April 1972 Agreement with Canada. Also, they are time-phased to retain flexibility

of decisions on the treatment technology option until 1980. These seven years should be profitably used to answer a number of questions relating to each technology and to generate public support necessary for implementation. The public should support early State assignment of high priority to local cost-effective projects consistent with the overall plan. These projects can be funded under the Federal EPA construction grant program. Experience with these projects over the next few years will contribute to a well-informed decision on selection of the plan.

The decision between Plans A-II and B must be made no later than 1975 since all communities must have plants in operation or under construction at that time to meet best available technology. Plan C is activated sludge/advanced biological/physical-chemical until 1980, so a decision to move from Plan A-II or Plan B to Plan C need not be made until that time. Once a decision is made to construct the transmission tunnel to the Northcentral area, the commitment to Plan C is final.

Plan C could be expanded to a pure land plan if the overland runoff/infiltration concept for Akron is acceptable. The Cleveland plants all revert to land treatment in the Northcentral area by the year 2000.

Summary costs of the four plans are presented in Tables 37 and 38. In Table 37 the total present worth of each plan is shown

for several interest rates in order to cover the range of interest rates that might be applicable. All future comparisons in the study are based on the rate of 7 percent.

Although other methods of obtaining land treatment areas are available and, in fact, preferred, costs for land treatment components of the plans include purchase of all necessary lands in order to provide a conservative estimate of costs. It is proposed that land be left in the ownership of the individual farmer or at least to an incorporated group of farmers. It is considered that through agreement and cooperation, lease or easement arrangements can be made. Any of these options would reduce the costs for Plan B and Plan C shown in Tables 37 and 38. The aerated lagoon and storage pond acreage would have to be purchased.

The land costs in Plan B are approximately $11 million, and the land costs of Plan C are approximately $93 million. The purchase of this land would remove a considerable amount of land from tax revenue. This could be as much as 14 percent of a total county revenue. The impact is greater for the counties in the Northcentral area than in-basin. The total tax loss could be as much as $1.5 million per year for Plan C. This can be avoided by obtaining the use of the land. Any cooperative arrangement reduces not only the tax loss impact but the social and community disruption impact as well.

TABLE 37
SUMMARY OF TOTAL PRESENT WORTH OF
PLANS A-I, A-II, B, C
(in Million $)

	Total Present Worth			
Interest Rate (%)	A-I	A-II	B	C
5-3/8	3,237	4,227	4,086	3,881
7	2,662	3,471	3,361	3,228
10	2,005	2,608	2,534	2,455

The amount of cost for industrial waste treatment should be subtracted from the above cost figures since industry will bear these costs or recycle as suggested in the previous chapter. The present worth costs to industry for each plan at 7 percent would be $0.803 billion for Plan A-I, $1.273 billion for Plan A-II, $1.276 billion for Plan B, and $1.269 billion for Plan C. The present worth costs to the public would then be $1.859 billion for Plan A-I, $2.198 billion for Plan A-II, $2.085 billion for Plan B, and $2.009 billion for Plan C.

TABLE 38

SUMMARY OF COSTS FOR PLANS[1/]

A-I, A-II, B, and C

(All in Million $, at 7% over 50 yrs.)

Plan	Study Area Share	Federal Share	Industrial Pretreatment	Total
A-I				
Capital (PW)[2/]	322.2	966.8	-	-
Capital (AA)[3/]	23.4	70.1	-	-
O & M (AA)	53.1	0	-	-
Total (AA)	76.5	70.1	46.3	192.9
A-II				
Capital (PW)	380.7	1,142.2	1,013.8	-
Capital (AA)	27.5	82.7	-	-
O & M (AA)	67.7	0	-	-
Total (AA)	95.2	82.7	73.5	251.4
B				
Capital (PW)	363.4	1,090.1	1,013.8	-
Capital (AA)	26.4	79.0	-	-
O & M (AA)	64.7	0	-	-
Total	91.1	79.0	73.5	243.6
C				
Capital (PW)	368.8	1,106.4	1,013.8	-
Capital (AA)	26.7	80.2	-	-
O & M (AA)	53.5	0	-	-
Total (AA)	80.2	80.2	73.5	233.9

1/ Study area taxpayer pays 25% Capital plus 100% O & M; Federal taxpayers pay 75% Capital Cost; Industry pays 100% of total pretreatment cost.

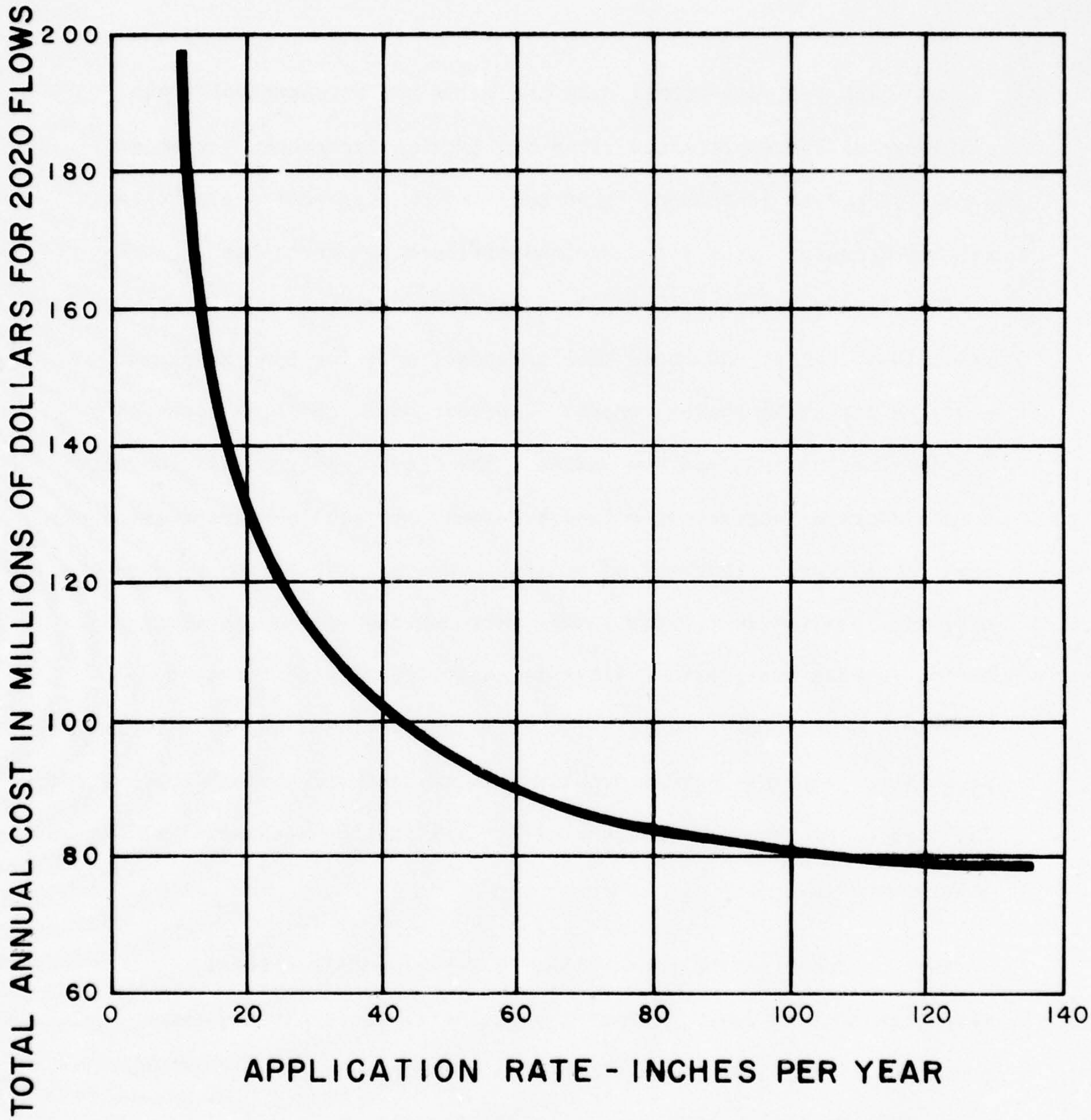
2/ PW = present worth

3/ AA = average annual

The rate of change in current crop patterns and farm techniques is directly related to the application rate of treated wastewater. By significantly reducing the application rate of treated wastewater, the current crop patterns and farm techniques may be maintained to a large degree.

The sensitivity analysis in Figure 30 shows the relationships between application rate and cost with land procurement. Again, the cost of land purchase was used only to provide comparative costs and is not, in fact, recommended. If the application rate were changed from 75 inches per year to 50 inches per year, the land requirement increases from 147,000 acres to 207,000 acres and the costs increase by $9.0 million annually compared to an average annual cost of Plan C (7 percent discount rate) of $238 million or less than 5 percent. Of greater value than the small differential cost is the increase in acceptability of Plan C that is provided by application rates that allow for crops and farming practices that are more similar to those now existing in the area.

The configuration of Plan C calls for a single lagoon, storage basin, and land treatment area. This is the most cost effective design, but also the most unacceptable from a social and public acceptance point of view. Smaller, dispersed sites would allow for system growth and create less of a problem in social growth of the area. The land necessary to have dispersed sites is available. The actual cost increase cannot be determined without design but would only affect transportation of effluent costs, diking of lagoons and storage basins. The amount of tile and irrigation equipment and land requirement is unaffected with the same application rate. If the State of Ohio is successful in establishing land treatment



NORTH CENTRAL OHIO LAND TREATMENT

SENSITIVITY ANALYSIS

PLAN C

FIGURE 30

early-action programs within both the basin and Northcentral areas that develop the application rates and farming techniques for those areas, then land treatment may be selected on a broader scale; this may not necessarily be for Cleveland effluent but certainly for the municipalities within both areas, other than Cleveland and Akron. Preliminary design and costs have been developed for land treatment projects for three typical areas. Information is shown in Appendix V for Bucyrus, Burton, and New Medina. The City of Bucyrus has indicated a considerable interest in a land treatment project to solve their local need for advanced treatment of municipal wastes. The large amounts of effluent involved in the two larger metropolitan areas, Cleveland and Akron, require transport of *sizeable quantities across* county and watershed boundaries creating difficult institutional and hydrological problems. The hydrological problems can be answered through engineering. The problem of governmental control (an institutional constraint) may be insurmountable.

With respect to the consumption of irreplaceable natural resources such as fuels, chemical coagulants, electrolytes, and absorbants after 1990, Plan C consumes less than 50 percent of the amount of chemicals than Plans A-II and B. Plan C consumes more than twice as much electrical power as either of the other plans. Plans B and C should benefit agriculture without the addition of commercial fertilizers. The annual consumption of natural resources is shown in

Table 39 for each of the four plans.

The cost of application of sludge to strip mines is six-tenths the cost of incineration. However, the City of Cleveland is planning to spend considerable money to upgrade incinerators for an additional 20-year use. This project should be constrained in its progress to allow for the assessment of an early-action project to apply sludge to stripmined land. A possible project is described in Appendix V. If that project is successful, use of incinerators should not continue and the savings achieved should be applied to the strip mine project. This will not only enhance Plan C to 1990 when secondary treatment in-basin is discontinued, but will enhance Plan A, to either level, and Plan B throughout the life of the project.

Plan C maximizes recycling of nutrients and/or insures biological control of nutrient cycles. Plan A to either level provides for the least disruption of hydrologic regimes in the Three Rivers Watershed.

The requirement for industry to pretreat according to Option 3 reduces the problem of total dissolved solids, a factor that no municipal technology will reduce.

In summary, Plan A-II has the least impact on watersheds. It is a totally advanced biological/physical-chemical configuration and

TABLE 39

RESOURCE REQUIREMENTS OF FOUR PLANS

YEAR AND PLAN	CHEMICALS (1000's TONS)			ELECTRIC POWER (1000's MWH)			LAND (1000's ACRES)			MANPOWER (PERSONS)		
	Waste-water	Storm-water	Total	Waste-water	Storm-water	Total	Waste-water	Storm-water	Total	Waste-water	Storm-water	Total
1980												
A-I	70.4	6.6	77.0	425.5	71.6	497.1	1.2	1.2	2.4	480	710	1,190
A-II	70.4	6.6	77.0	431.6	71.6	503.2	1.3	1.4	2.7	848	699	1,547
B	54.0	6.7	60.7	469.2	70.9	540.1	1.0	1.5	2.5	914	372	1,286
C	65.5	13.4	78.9	479.8	89.8	569.6	4.9	1.8	6.7	947	220	1,167
1990												
A-I	86.0	8.5	94.5	474.6	90.4	565.0	7.6	3.9	11.5	689	1,018	1,707
A-II	129.7	32.3	162.0	579.4	90.4	669.8	8.5	4.3	12.8	1,126	1,093	2,219
B	96.7	30.5	127.2	684.9	113.2	798.1	15.8	6.7	22.5	1,229	625	1,854
C	42.5	10.9	53.4	855.0	296.9	1,151.9	122.0	29.3	151.3	755	386	1,141
2000												
A-I	96.0	9.6	105.6	524.6	119.3	643.9	8.6	4.3	12.9	831	1,229	2,060
A-II	144.8	38.2	183.0	639.2	119.3	758.5	9.5	4.8	14.3	1,143	1,535	2,678
B	108.7	34.1	142.8	770.8	137.8	908.6	19.3	9.2	28.5	1,241	854	2,095
C	43.2	19.8	63.0	1,610.3	333.6	1,943.9	139.6	35.2	174.8	953	566	1,519
2010												
A-I	106.7	10.6	117.3	579.0	130.6	709.6	9.7	4.6	14.3	838	1,240	2,078
A-II	160.9	41.2	202.1	703.1	130.6	833.7	10.6	5.1	15.7	1,163	1,539	2,702
B	121.9	36.7	158.6	855.3	154.7	1,010.0	23.1	10.2	33.3	1,288	866	2,154
C	38.3	20.4	58.7	1,619.8	315.9	1,935.7	154.7	38.5	193.2	1,019	582	1,601
2020												
A-I	116.5	11.2	127.7	625.5	142.8	768.3	11.1	4.7	15.8	844	1,250	2,094
A-II	175.6	44.0	219.6	760.0	142.8	902.8	12.4	5.2	17.6	1,180	1,543	2,723
B	133.4	38.5	171.9	940.8	166.6	1,107.4	26.9	11.1	38.0	1,330	875	2,205
C	43.4	21.5	64.8	1,753.4	606.8	2,360.2	169.0	40.8	209.8	1,076	593	1,669

is all in-basin. Plan B is similar to Plan A-II except that the upper basins employ treatment on land with aerated lagoons giving the secondary treatment to the effluent prior to its application on land. The option remains to continue using existing activated sludge plants. The aspect of in-basin land treatment has met with little opposition. If the overland flow/infiltration concept proves acceptable, Akron could also employ treatment on land (on Mahoning-Ellsworth type soils), thereby increasing land treatment and the ability to recycle nutrients.

Tables 40, 41, 42, and 43 provide a summary of impacts produced by each of the four alternative plans on the various groups - Three Rivers Watershed, Rest of Ohio, Lake Erie Region, Rest of United States, and International - who are impacted by the plans. The tables display the impacts of the plans in the various parameters including ecological effects, land and water use changes, land values, revenues, public perception, institutional effects, and costs. These impacts were then used to develop preference sets for the residents of the Three Rivers Watershed, the residents of Northcentral Ohio, the residents of the rest of Ohio, and the residents of the rest of the United States. These preference sets are shown in Tables 44, 45, 46, and 47 in Chapter 8 and will assist in selecting a preferred plan.

Table 40

Summary of Impacts Produced by Plan A at Level I

Impact Parameter	Three Rivers Watershed: Study Area Taxpayers	Three Rivers Watershed: Stream Bank Owners	Three Rivers Watershed: Owners of System Required Lands: Farmers	Three Rivers Watershed: Owners of System Required Lands: Residential	Three Rivers Watershed: Miscellaneous Interest Groups	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Residential	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Farms	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Unproductive Lands	Rest of Ohio: Ohio Taxpayers	Lake Erie Region: Commercial Fishing	Lake Erie Region: Lake Shore Owners	Rest of United States: Federal Taxpayers	Rest of United States: Farmers	Rest of United States: Miscellaneous Interest Groups	International
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Ecological																
Effluent Water Requirements Quality (mg/l): BOD_5 [illegible]; Phosphorus [illegible]; Nitrogen [illegible]; Suspended Solids 8; Total Dissolved Solids [illegible]	Produces a measurable increase in dissolved oxygen. Reduces phosphorus discharges by 49 percent from municipal and industrial sources thereby reducing the potential for algal blooms.					---	---	---	---	This plan would provide water of the quality required by the State of Ohio standards, except in the Navigation Channel of the Cuyahoga River. It does contribute its proportional share to an overall plan to reduce pollution in the State.	This plan would be consistent with and contribute its proportional share to an overall plan to reduce pollution in Lake Erie.		Does not meet the 1985 goal of Public Law 92-500, but meets its time phasing through 1983.			Meets the intent and time phasing of the April 1972 Agreement with Canada on Great Lakes Water Quality.
Aquatic Life	---	Provides potential habitat for desirable sport fish species.	---	---	Provides potential habitat for desirable sport fish species.	---	---	---	---		Contributes to potential habitat improvement for reestablishment of desirable commercial and sport fish species.		---	---	Partially fulfills goals of relevant conservation groups.	Contributes to potential habitat for reestablishment of desirable commercial and sport fish species.
Terrestrial Life	Increase in birds and other animals which feed on the aquatic organisms which inhabit the improved water courses					---	---	Potential improvement of habitat for game species.			---	---	---	---	---	---
Resource requirements	---	---	3,000 acres purchased in fee for plants. 5,000 acres for sludge should be leased or acquired, through easement.		---	---	---	At least 750 acres per year in 2020 to be leased or obtained through easement.		---	---	---	---	---	270 tons/day of treatment chemicals; 2000 megawatt hours of power are required.	---
Land and Water Use Changes																
Outdoor Recreation	Provides for increased recreation areas along water courses.		---	---	Increased usage of existing and newly developed water based recreation areas.	---	---	Potential increase in recreational lands in strip mined areas for hunting, camping and related recreation activities.		---	---	Potential increase in water based recreation.	Potential increase in total recreation opportunities.	---	Potential increase in total recreation opportunities	Insignificant increase at bathing beaches.
Agriculture	---	---	Retain 5,000 acres in agricultural production.	---	---	---	---	Useful production on lands treated with sludge.		---	---	---	---	---	---	---
Aesthetics	Significant enhancement of water courses.		---	---	Significant enhancement of water courses.	---	---	Very significant enhancement of strip mine lands through successful land restorations, decreased stream siltation.		---	---	Reduction of algal blooms.	---	---	---	Reduction of algal blooms.
Flood Control	Possible flood control for small floods		---	---	---	---	---	Potential reduction in storm runoff due to revegetation.		---	---	---	Insignificant reduction in flood damage costs.	---	---	---
Open Space	Slight enhancement through increased recreation areas.		---	---	Slight enhancement through increased recreation areas.	---	---	Potential reduction due to increased development on restored lands.		---	---	---	---	---	---	---
Land Values																
Potential Unrecovered Losses 1/	Minor loss from property tax roles for lands purchased	---	---	Anything in addition to reimbursement for full market value of land and relocation assistance.	---	---	---	---	---	---	---	---	---	---	---	---
Potential Unpaid-for Gain	Tax revenue gain and increase in property value.	Enhanced property values along streams of improved quality.	---	---	---	---	---	Potential major increase in land values due to revegetation of strip mined lands together with an increase in local economic base, and improved productivity of farm lands.		---	Contributes to potential for improved commercial fishery.	Enhanced property values along lake shore.	---	---	---	Contributes to potential for improved commercial fishery.

Table 40 (Continued)

Summary of Impacts Produced by Plan A at Level I

Impact Parameters	Three Rivers Watershed: Study Area Taxpayers	Three Rivers Watershed: Stream Bank Owners	Three Rivers Watershed: Owners of System Required Lands: Farmers	Three Rivers Watershed: Owners of System Required Lands: Residential	Three Rivers Watershed: Miscellaneous Interest Groups	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Residential	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Farmers	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Unproductive Lands	Ohio Taxpayers	Lake Erie Region: Commercial Fishing	Lake Erie Region: Lake Shore Owners	Rest of United States: Federal Taxpayers	Rest of United States: Farmers	Rest of United States: Miscellaneous Interest Groups	International
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Revenues from Recycling & Reuse																
Agriculture	---	---	---	---	---	---	---	Sludge applications may stimulate agricultural production.		---	---	---	---	Insignificant	---	---
Industrial Manufacturing	---	---	---	---	Industries experience net increase in wastewater treatment costs.	---	---	---	---	---	---	---	---	---	Potential increase in unit prices.	---
Power Plants	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Solid Waste	---	---	---	---	---	---	---	Sludge application can be coordinated with proposed solid waste recycle industries in strip mine areas		---	---	---	---	---	---	---
Employment	Potential employment of 2,700 persons to operate and maintain highly technical municipal and stormwater treatment plants.					---	---	Slight increase in number of persons employed in restored agricultural and recreation activities.		---	---	---	---	---	---	---
Public Perception	Decrease in disposable income due to increased sewage charges; enhancement of water resources.	Enhancement of property values and recreation potential.	Inconvenience and anxiety of relocation; some disruption of community cohesion.		Potential increase in total recreational opportunities.	---	---	Revegetation of currently unproductive lands and enhancement of currently marginally productive lands.		Improved water quality to help reduce pollution in the State and revegetation of strip mines.	Potential for an increase in commercial fishing economic base.	Enhancement of property values and recreation potentials.	Does not meet the intent of Public Law 92-500.			Meets the intent and time phasing of April 1972 Agreement with Canada on Great Lakes Water Quality.
Institutional	Coordination throughout the watershed is necessary or a single institution should be created.					This is the Northeast Ohio Water Development Plan upgraded to meet proposed state effluent standards. Enabling legislation is required to create a single institution, if selected.				---	This plan meets the Ten States Standards for water quality.		Does not meet the intent of Public Law 92-500.			Meets the intent and time phasing of April 1972 Agreement with Canada on Great Lakes Water Quality.
Project Costs																
Capital ($$10^6$ Present Worth)2/	$ 322.2	---	---	---	---	---	---	---	---	$0.0	---	---	$ 966.8			---
Capital ($$10^6$ Average Annual)2/	$ 23.4	---	---	---	---	---	---	---	---	$0.0	---	---	$ 70.1			---
Operation & Maintenance ($$10^6$ Average Annual)	$ 53.1	---	---	---	---	---	---	---	---	$0.0	---	---	$ 0.0			---
Total ($$10^6$ Average Annual)	$ 76.6	---	---	---	---	---	---	---	---	$0.0	---	---	$ 70.1			---
Industrial Pretreatment ($$10^6$ Average Annual at 7%)	---	---	---	---	$ 46.3	---	---	---	---	$0.0	---	---	---			---

TOTAL AVERAGE ANNUAL COST - Plan A-I

$192.9 million

1/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of full market value for land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

2/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio, and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

NOTE: The word "potential", as used in this table, refers to the impacts which could occur if this plan for the Three Rivers Watershed was combined with similar plans in the rest of Ohio and elsewhere in the Nation.

Table 41

Summary of Impacts Produced by Plan A at Level II

Impact Parameters	Study Area Taxpayers (1)	Stream Bank Owners (2)	Owners of System Required Lands: Farmers (3)	Owners of System Required Lands: Residential (4)	Miscellaneous Interest Groups (5)	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers (6)	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Residential (7)	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Farms (8)	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Unproductive Land (9)	Ohio Taxpayers (10)	Lake Erie Region: Commercial Fishing (11)	Lake Erie Region: Lake Shore Owners (12)	Rest of United States: Federal Taxpayers (13)	Rest of United States: Farmers (14)	Rest of United States: Miscellaneous Interest Groups (15)	International (16)
Biological																
Effluent Water Requirements Quality (mg/liter) BOD <5 COD <10 Phosphorus <0.5 Nitrogen <5 Suspended Solids <5 Total Dissolved Solids <500	Produces a measurable increase in dissolved oxygen. Reduces phosphorus discharges by 99 percent and nitrogen discharges by 97 percent from municipal and industrial sources--thereby reducing the potential for algal blooms.					---	---	---	---	This plan would provide water of better quality than is required by proposed State of Ohio standards. It contributes its proportional share to an overall plan to reduce pollution in the State.	This plan would be consistent with and contribute its proportional share to an overall plan to reduce pollution in Lake Erie.		Meets the intent and time-phased goals of Public Law 92-500.			Meets the intent and time-phasing of the April 1972 Agreement with Canada on Great Lakes Water Quality.
Aquatic Life	---	Provides potential habitat for desirable sport fish species.	---	---	Provides potential habitat for desirable sport fish species.	---	---	---	---	---	Contributes to potential habitat improvement for the reestablishment of desirable commercial and sport fish species.		---	---	Fulfills goals of relevant conservation groups.	Contributes to potential habitat for reestablishment of desirable commerical and sport fish species.
Terrestrial Life	Increase in birds and other animals which feed on the aquatic organisms which inhabit the improved water courses.					---	---	Potential improvement of habitat for game species.		---	---	---	---	---	---	---
Resource Requirements	---	---	3,000 acres purchased in fee for plants. 5,000 acres for sludge should be leased or obtained through easement.		---	---	---	At least 810 acres per year in 2020 to be leased or obtained through easement.		---	---	---	---	---	600 tons/day of treatment chemicals; 2,480 megawatt hours of power are required.	---
Land and Water Use Changes																
Outdoor Recreation	Provides for increased recreation areas along water courses.		---	---	Increased usage of existing and newly developed water based recreation areas.	---	---	Potential increase in recreational lands in strip mined areas for hunting, camping and related recreation activities.			---	---	---	---	---	---
Agriculture	---	---	Retain 5,000 acres in agricultural production.	---	---	---	---	Useful production from lands treated with sludge.		---	---	---	---	---	---	---
Aesthetics	Significant enhancement of water course.		---	Significant enhancement of water courses.		---	---	Very significant enhancement of strip mine lands through successful land restorations, decreased stream siltation. Improve farmlands.			---	Reduction of algal blooms.	---	---	---	Reduction of algal blooms.
Flood Control	Possible flood control for small floods.		---	---	---	---	---	Potential reduction in storm runoff due to revegetation.			---	---	Insignificant reduction in flood damage costs.	---	---	---
Open Space	Slight enhancement through increased recreation areas.		---	---	---	---	---	Potential reduction due to increased development on restored lands.		---	---	---	---	---	---	---
Land Values																
Potential Unrecovered Losses	Minor loss from property tax roles for land purchased.	---	---	Anything in addition to reimbursement for full market value of land and relocation assistance.	---	---	---	---	---	---	---	---	---	---	---	---
Potential Unpaid-for Gain	Tax revenue gain and increase in property value.	Enhanced property values along streams of improved quality.	---	---	---	---	---	Potential major increase in land values due to revegetation of strip mined lands together with an increase in local economic base.		---	Contributes to potential for improved commercial fishery.	Enhanced property values along lake shore.	---	---	---	Contributes to potential for improved commercial fishery.

Table 41 Continued

Summary of Impacts Produced by Plan A at Level II

[illegible]	Three Rivers Watershed: Study Area Taxpayers	Three Rivers Watershed: Stream Bank Owners	Three Rivers Watershed: Owners of System Required Lands: Farmers	Three Rivers Watershed: Owners of System Required Lands: Residential	Three Rivers Watershed: Miscellaneous Interest Groups	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Residential	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Farms	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Unproductive Lands	Ohio Taxpayers	Lake Erie Region: Commercial Fishing	Lake Erie Region: Lake Shore Owners	Rest of United States: Federal Taxpayers	Rest of United States: Farmers	Rest of United States: Miscellaneous Interest Groups	International
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
[illegible]																
Agriculture	---	---	---	---	Potential reduction in demand for commercial fertilizer	---	---	Sludge applications may stimulate agricultural production.		---	---	---	---	Insignificant.	---	---
Industrial Manufacturing	---	---	---	---	Industries experience net increase in wastewater treatment costs.	---	---	---	---	---	---	---	---	---	Potential increase in unit prices.	---
Power Plants	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Solid Waste	---	---	---	---	---	---	---	Sludge application can be coordinated with proposed solid waste recycle industries in strip mine areas.		---	---	---	---	---	---	---
Employment	Potential employment of 2,700 persons to operate and maintain highly technical municipal and stormwater treatment plants.					---	---	Slight increase in number of persons employed in restored agricultural and recreation activities.		---	---	---	---	---	---	---
Public Perception	Decrease in dispensable income due to increased sewage charges; enhancement of water resources.	Enhancement of property values and recreation potential.	---	Inconvenience and anxiety of relocation; some disruption of community cohesion.	Potential increase in total recreational opportunities.	---	---	Revegetation of currently unproductive lands and enhancement of currently marginally productive lands.		Improved water quality to help reduce pollution in the State and revegetation of strip mines.	Potential for an increase in commercial fishing economic base.	Enhancement of property values and recreation potentials.	Meets the intent of PL 92-500.			Meets the intent and time phasing of April 1972 Agreement wit Canada on Great Lakes Water Quality
Institutional	Coordination throughout the watershed is necessary or a single institution should be created.					This is the Northeast Ohio Plan upgraded to Level II, enabling legislation is required to create a single institution. Coordination of revegetation and reforestation is necessary throughout the region.				---	This plan meets the Ten States standards for water quality.		Meets the intent of PL 92-500.			Meets the intent and time phasig of April 1972 Agreement wit Canada on Great Lakes Water Quality
Project Costs																
Capital ($10^6 Present Worth) 2/	$380.7	---	---	---	---	---	---	---	---	$0.0	---	---	$1,142.2			---
Capital ($10^6 Average Annual) 2/	$ 27.5	---	---	---	---	---	---	---	---	$0.0	---	---	$ 82.7			---
Operation & Maintenance ($10^6 Average Annual) 2/	$ 67.7	---	---	---	---	---	---	---	---	$0.0	---	---	$ 0.0			---
Total ($10^6 Average Annual) 2/	$ 95.2	---	---	---	---	---	---	---	---	$0.0	---	---	$ 82.7			---
Industrial Pretreatment ($10^6 Average Annual at 7%)	---	---	---	---	$73.5	---	---	---	---	$0.0	---	---	$ 0.0			---

TOTAL AVERAGE ANNUAL COST - Plan A-II

$251.4 million

1/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of full market value for land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

2/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

NOTE: The word "potential", as used in this table, refers to the impacts which could occur if this plan for the Three Rivers Watershed was combined with similar plans in the rest of Ohio and elsewhere in the Nation.

Table 42

Summary of Impacts Produced by Plan [illegible] at Level II

Impact Parameters	Three Rivers Watershed: Study Area Taxpayers	Three Rivers Watershed: Stream Bank Owners	Three Rivers Watershed: Owners of System Required Lands: Farmers	Three Rivers Watershed: Owners of System Required Lands: Residential	Three Rivers Watershed: Miscellaneous Interest Groups	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Residential	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Farms	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Unproductive Lands	Ohio Taxpayers	Lake Erie Region: Commercial Fishing	Lake Erie Region: Lake Shore Owners	Rest of United States: Federal Taxpayers	Rest of United States: Farmers	Rest of United States: Miscellaneous Interest Groups	International
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Ecological																
Effluent Water Requirements Quality (mg/liter) BOD5 <5 COD <10 Phosphorus <0.5 Nitrogen <5 Suspended Solids <5 Total Dissolved Solids <500	Produces a measurable increase in dissolved oxygen. Reduces phosphorus discharges by 99 percent and nitrogen discharges by 97 percent from municipal and industrial sources, thereby reducing the potential for algal blooms.					---	---	---	---	This plan would provide water of better quality than is required by proposed State of Ohio standards. It contributes its proportional share to an overall plan to reduce pollution in the State.	This plan would be consistent with and contribute its proportional share to an overall plan to reduce pollution in Lake Erie.		Meets the intent and time phased goals of Public Law 92-500.			Meets the intent and time phasing of the April 1972 Agreement with Canada on Great Lakes Water Quality
Aquatic Life	---	Provides potential habitat for desirable sport fish species.	---	---	Provides potential habitat for desirable sport fish species.	---	---	---	---		Contributes to potential habitat improvement for the reestablishment of desirable commercial and sport fish species.		---	---	Fulfills goals of relevant conservation groups.	Contributes to potential habitat for reestablishment of desirable commercial and sport fish species.
Terrestrial Life	Increase in birds and other animals which feed on the aquatic organisms which inhabit the improved water course.					---	---	Potential improvement of habitat for game species.		---	---	---	---	---	---	---
Resource Requirements	---	---	3,000 acres purchased in fee for plants, 3,000 acres for sludge and 20,000 acres for land treatment should be leased or obtained through easement.		---	---	---	At least 810 acres per year in 2020 to be leased or obtained through easement.		---	---	---	---	---	470 tons/day of treatment chemicals; 3030 megawatt hours/day of power are required.	---
Land and Water Use Changes																
Outdoor Recreation	Provides for increased recreation areas along water courses.		---	---	Increased usage of existing and newly developed water based recreation areas.	---	---	Potential increase in recreational lands in strip mined areas for hunting, camping and related recreation activites.			---	Potential increase in water based recreation.	Potential increase in total recreation opportunities.	---	Potential increase in total recreation opportunities.	Insignificant increase at bathing beaches.
Agriculture	---	---	Retain 23,000 acres in agricultural production.	---	---	---	---	Useful production from lands treated with sludge.		---	---	---	---	---	---	---
Aesthetics	Significant enhancement of water courses.		---	Significant enhancement of water courses.		---	---	Very significant enhancement of strip mine lands through successful land restorations, decreased stream siltation. Improve farm lands.			---	Reduction of algal blooms.	---	---	---	Reduction of algal blooms.
Flood Control	Possible flood control for small floods.		---	---	---	---	---	Potential reduction in storm runoff due to revegetation.		---	---	---	Insignificant reduction in flood damage costs.	---	---	---
Open Space	2[illegible],000 acres of land will be potentially available for creation and maintenance of open space.				---	---	---	Potential reduction due to increased development on restored lands.		---	---	---	---	---	---	---
Land Values																
Potential Unrecovered Losses	Minor loss from property tax roles for lands purchased.	---	Anything in addition to reimbursement for full market value of land and relocation assistance.		---	---	---	---	---	---	---	---	---	---	---	---
Potential Unpaid-for Gain	Tax revenue gain and increase in property value.	Enhanced property values along streams of improved quality.	Potential increase in crop production land values, and reduced costs. Capital improvements to land for drains and irrigation equipment.		---	---	---	Potential major increase in land values due to revegetation of strip minded lands together with an increase in local economic base.		---	Contributes to potential for improved commercial fishery.	Enhanced property values along lake shore.	---	---	---	Contributes to potential for improved commercial fishery.

Table 42 (Continued)

Summary of Impacts Produced by Plan B at Level II

Impact Parameters	Three Rivers Watershed: Study Area Taxpayers	Stream Bank Owners	Owners of System Required Lands: Farmers	Residential	Miscellaneous Interest Groups	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers	Residential	Owners of System Required Lands in Strip Mine Areas: Farms	Unproductive Lands	Ohio Taxpayers	Lake Erie Region: Commercial Fishing	Lake Shore Owners	Rest of United States: Federal Taxpayers	Farmers	Miscellaneous Interest Groups	International
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Revenues from Recycling & Reuse																
Agriculture	Potential increase in dairying due to increased forage at a decreased price.	---	Equivalent fertilizer value-$60.00 per acre per year.	---	Potential reduction in demand for commercial fertilizer.	---	---	Sludge applications may stimulate agricultural production.		---	---	---	---	Insignificant.	Potential reduction in demand for commercial fertilizer.	---
Industrial Manufacturing	Potential increase in dairy processing and dairy support industries.	---	Sufficient quality in drainage water for process use by industry.		Industries experience net increase in wastewater treatment costs.	---	---	---	---	---	---	---	---	---	Potential increase in unit prices.	---
Power Plants	---	---	Winter storage basins useful for power plant cooling.		---	---	---	---	---	---	---	---	---	---	---	---
Solid Waste	---	---	---	---	---	---	---	Sludge application can be coordinated with proposed solid waste recycle industries in strip mine areas.		---	---	---	---	---	---	---
Employment	Potential employment of 2,200 persons to operate and maintain highly technical municipal and stormwater treatment plants.					---	---	Slight increase in number of persons employed in restored agricultural and recreation activites.		---	---	---	---	---	---	---
Public Perception	Decrease in disposable income due to increased sewage charges; enhancement of water resources.	Enhancement of property values and recreation potential.	Anxiety from interest acquisition proceedings, inconveniences, and some disruption of community cohesion.		Potential increase in total recreational opportunities.	---	---	Revegetation of currently unproductive lands and enhancement of currently marginally productive lands.		Improved water quality to help reduce pollution in the State and revegetation of strip mines.	Potential for an increase in commercial fishing economic base.	Enhancement of property values and recreation potentials.	Meets the intent of PL 92-500.			Meets the intent and time phasing of April 1972 Agreement with Canada on Great Lakes Water Quality.
Institutional	Coordination throughout the watershed is necessary or a single institution should be created.					---	---	Coordination of revegetation and restoration is necessary throughout the region. Enabling legislation necessary to create regional institutions.		---	This plan meets the Ten States Standards for water quality.		Meets the intent of PL 92-500.			Meets the intent and time phasing of April 1972 Agreement with Canada on Great Lakes Water Quality
Project Costs																
Capital ($10^6 Present Worth) 2/	$363.4	---	---	---	---	---	---	---	---	$0.0	---	---	$1,090.1			---
Capital ($10^6 Average Annual) 2/	$ 26.4	---	---	---	---	---	---	---	---	$0.0	---	---	$ 79.0			---
Operation & Maintenance ($10^6 Average Annual) 2/	$ 64.7	---	---	---	---	---	---	---	---	$0.0	---	---	$ 0.0			---
Total ($10^6 Average Annual) 2/	$ 91.1	---	---	---	---	---	---	---	---	$0.0	---	---	$ 79.0			---
Industrial Pretreatment ($10^6 Average Annual at 7%) 2/	---	---	---	---	$73.5	---	---	---	---	$0.0	---	---	---			---

TOTAL AVERAGE ANNUAL COST - Plan B

$243.6 million

1/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of full market value for land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

2/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

NOTE: The word "potential", as used in this table, refers to the impacts which could occur if this plan for the Three Rivers Watershed was combined with similar plans in the rest of Ohio and elsewhere in the Nation.

Table 43

Summary of Impacts Produced by Plan C at Level II

Impact Parameters	Three Rivers Watershed					Rest of Ohio					Lake Erie Region		Rest of United States			International
	Study Area Taxpayers	Stream Bank Owners	Owners of System Required Lands		Miscellaneous Interest Groups	Owners of System Required Lands in North Central Ohio		Owners of System Required Lands in Strip Mine Area		Ohio Taxpayers	Commercial Fishing	Lake Shore Owners	Federal Taxpayers	Farmers	Miscellaneous Interest Groups	
			Farmers	Residential		Farmers	Residential	Farms	Unproductive Lands							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Ecological																
Effluent Water Requirements Quality (mg/liter) BOD_5 <5, COD <10, Phosphorus <0.5, Nitrogen <5, Suspended Solids <5, Total Dissolved Solids <500	Produces a measurable increase in dissolved oxygen. Reduces phosphorus discharges by 99 percent and nitrogen discharges by 97 percent from municipal and industrial sources, thereby reducing the potential for algal blooms.					Drainage from land treatment areas will improve local water quality by dilution.		---	---	This plan would provide water of better quality than is required by proposed State of Ohio standards. It contributes its proportional share to an overall plan to reduce pollution in the State.	This plan would be consistent with and contribute its proportional share to an overall plan to reduce pollution in Lake Erie.		Meets the intent and time phased goals of Public Law 92-500.			Meets the intent and time phasing of the April 1972 Agreement with Canada on Great Lakes Water Quality.
Aquatic Life	---	Provides potential habitat for desirable sport fish species.	---	---	Provides potential habitat for desirable sport fish species.	Increased flow may damage some fish habitat and benthic communities.		---	---		Contributes to potential habitat improvement for the reestablishment of desirable commercial and sport fish species.		---	---	Fulfills goals of relevent conservation groups.	Contributes to potential habitat for reestablishment of desirable commercial and sport fish species.
Terrestrial Life	Provides potential increase in wildlife which feed on aquatic life which inhabit improved water courses.					Increased water surface decreases habitat. Standing water may increase mosquito areas.		---	---	---	---		---	---	---	---
Resource Requirements	---	---	3,000 acres purchased in fee for storage basins and aerated lagoons, 7,600 acres for sludge and 28,000 acres for land treatment should be leased or obtained through easement.			147,000 acres of farm and residential lands are required, necessary interest obtained by lease or easement. 14,000 acres for lagoons and basins are purchased.		---	---	---	---		---	---	180 tons/day of treatment chemicals; 6,470 megawatt hours/day of power are required.	---
Land and Water Use Changes																
Outdoor Recreation	Provides for increased recreation areas along water courses.		---	---	Increased usage of existing and newly developed water based recreation areas.	Game species will be maintained. Improved stream quality enhances water based recreation.		---	---	---	---	Potential increase in water based recreation.	Potential increase in total recreation opportunities.	---	Potential increase in total recreation opportunities.	Insignificant increase at bathing beaches.
Agriculture	---	---	Retain 23,000 acres in agricultural production.	---	---	Retain 118,000 acres in agricultural production.		---	---	---	---	---	---	---	---	---
Aesthetics	Significant enhancement of water courses.		Potential for infrequent odors from lagoons.	Significant enhancement of water courses.		Potential for infrequent odors from lagoons.		---	---	---	---	Reduction of algal blooms.	---	---	---	Reduction of algal blooms.
Flood Control	Possible flood control for small floods.		---	---	---	Additional flows in North Central Ohio streams may increase the volumes of small floods. These flows will significantly increase low flows.		---	---	---	---	---	Insignificant reduction in flood damage costs.	---	---	---
Open Space	23,000 acres of land will be potentially available for creation and maintenance of open space.			---	---	147,000 acres for creation and maintenance of open space, excepting locally desired development and industrial parks.		---	---	---	---	---	---	---	---	---
Land Values Potential Unrecovered Losses 1/	Minor loss from property tax roles for lands purchased.	Anything in addition to reimbursement for full market value of land and relocation assistance.			---	Anything in addition to reimbursement for full market value of land and relocation assistance.		---	---	---	---	---	---	---	---	---
Potential Unpaid for Gain	Tax revenue gain and increase in property value.	Enhanced property values along streams	Potential increase in crop production, land values, and reduced costs. Capital improvements to land for drains and irrigation equipment.		---	Capital improvements to the land including irrigation hardware and drains, pl-- improved fertility.		---	---	---	Contributes to potential for improved commercial fishery.	Enhanced property values along lake shore.	---	---	---	Contributes to potential for improved commercial fishery.

Table 43 Continued

Summary of Impacts Produced by Plan C at Level II

Impact Parameters	Three Rivers Watershed: Study Area Taxpayers	Three Rivers Watershed: Stream Bank Owners	Three Rivers Watershed: Owners of System Required Lands: Farmers	Three Rivers Watershed: Owners of System Required Lands: Residential	Three Rivers Watershed: Miscellaneous Interest Groups	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Farmers	Rest of Ohio: Owners of System Required Lands in North Central Ohio: Residential	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Farmers	Rest of Ohio: Owners of System Required Lands in Strip Mine Area: Unproductive Lands	Ohio Taxpayers	Lake Erie Region: Commercial Fishing	Lake Erie Region: Lake Shore Owners	Rest of United States: Federal Taxpayers	Rest of United States: Farmers	Rest of United States: Miscellaneous Interest Groups	International
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Revenues from Recycling & Reuse Agriculture	Potential increase in dairying due to increased forage at a decreased price.	---	Equivalent fertiliser value, $60/acre/yr.	---	Potential reduction in demand for commercial fertiliser.	Estimated value of nutrients recycled as fertiliser is $60/acre/yr.		---	---	---	---	---	---	Potential significant impact on crop market values	Potential reduction in demand for commercial fertiliser.	---
Industrial Manufacturing	Potential increase in dairy processing and dairy support industries.	---	Sufficient quality in drainage water for process use by industry.		Industries experience net increase in wastewater treatment costs.	Sufficient quality in drainage water for process use by industry.		---	---	---	---	---	---	---	Potential increase in unit prices	---
Power Plants	---	---	Winter storage basins useful for power plant cooling.		---	Sufficient quantity of water in storage basins for cooling water by power plants.		---	---	---	---	---	---	---	---	---
Solid Waste	---	---	---	---	---	---		---	---	---	---	---	---	---	---	---
Employment	---	---	---	---	Potential employment of 1700 persons both within the watershed and the rest of Ohio in this plan.			---	---	---	---	---	---	---	---	---
Public Perception	Decrease in disposable income due to increased sewage charges; enhancement of water resources.	Enhancement of property values and recreation potential.	Anxiety from interest acquisition proceedings, inconvenience, and some disruption of community coshesion.		Potential increase in total recreational opportunities.	Potential anxiety of farmers and residents from interest acquisition proceedings, disruption of community cohesion, and change in farming practices. Potential increase in local economy. Reluctance to accept metropolitan wastes, especially when only primarily treated.		---	---	Improved water quality to help reduce pollution in the State	Potential for an increase in commercial fishing economic base.	Enhancement of property values and recreation potentials.	Meets the intent of PL 92-500.			Meets the intent and time-phasing of April 1972 Agreement with Canada on Great Lakes Water Quality.
Institutional	Coordination throughout the watershed with the rest of Ohio is necessary. New institutions should be created to increase efficiency of management and operation.					Coordination of treatment and crop production is necessary throughout the region. A regional institution or cooperative may be created to monitor treatment and crop production. Enabling legislation necessary to create regional institutions.		---	---	---	This plan meets the Ten States Standards for water quality.		Meets the intent of PL 92-500.			Meets the intent and time-phasing of April 1972 Agreement with Canada on Great Lakes Water Quality.
Project Costs Capital ($$10^6$$ Present Worth) 2/	$368.8	---	---	---	---	---		---	---	$0.0	---	---	$1,106.4			---
Capital ($$10^6$$ Average Annual) 2/	$ 26.7	---	---	---	---	---		---	---	$0.0	---	---	$ 80.2			---
Operation and Maintenance ($$10^6$$ Average Annual) 2/	$ 53.5	---	---	---	---	---		---	---	$0.0	---	---	$ 0.0			---
Total ($$10^6$$ Average Annual) 2/	$ 80.2	---	---	---	---	---		---	---	$0.0	---	---	$ 80.2			---
Industrial Pretreatment ($$10^6$$ Average Annual at 7%) 2/	---	---	---	---	$73.5	---		---	---	$0.0	---	---	---			---

TOTAL AVERAGE ANNUAL COST
Plan C
$233.9 million

1/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of full market value for land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

2/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

NOTE: The word "potential", as used in this table, refers to the impacts which could occur if this plan for the Three Rivers Watershed was combined with similar plans in the rest of Ohio and elsewhere in the Nation.

CHAPTER 8

PREFERENCE SETS FOR CHOICE AMONG ALTERNATIVE PLANS

A. Introduction

In Chapter 7 the four alternative plans retained for preliminary design were described in detail, including presentation of information on impacts and time-phasing to achieve the water quality goals specified in P.L. 92-500. The purpose of this chapter is to organize these impacts or effects in terms of "preference sets" that should facilitate choice, or the expression of a preference, by those affected among the alternative plans. Ultimately, of course, the State of Ohio must certify a particular plan and assign priority to it for funding, and the Federal Environmental Protection Agency must approve these decisions.

B. Preference Sets for Residents of the Three Rivers Watershed

Table 44 contains preference sets that should assist residents of the Three Rivers Watershed in choosing among the four alternative plans. A basic assumption in formulating this and other preference sets is that for any plan certified by the State of Ohio and approved by the Federal EPA, the Federal Government will finance 75 percent of the capital cost, and that the study area residents will finance 25 percent of the capital cost and 100 percent of the operation and maintenance costs; all costs were estimated over 50 years at 7 percent interest.

As can be seen from the Preference Set in Table 45, in order for the the residents of the Three Rivers Watershed to choose Plan A-I over the other three plans, they would have to forego (or postpone for later consideration) the opportunity to approach the 1985 water quality goal of P.L. 92-500. This means they would forego the opportunity to: (1) maximize retardation of eutrophication of Lake Erie (The Lake Erie Study, authorized in Section 108 (d) of PL 92-500, will demonstrate the contribution of these Plans to the retardation of eutrophication); (2) provide additional increments of water quality, inherent in the other plans, which maximize the enhancement of water-based recreation, sport and commercial fishing, and open space; (3) recycle nutrients and other potential resources contained in the wastewater.

On the other hand, in order to choose one of the other alternative plans and thus take advantage of these opportunities foregone, residents of the Three Rivers Watershed would have to be willing to increase study area taxpayers' costs by at least $10,700,000 annually to achieve Level II water quality. Also, they may have to be willing to pursuade farmers, either through contracts or other appropriate arrangements, to accept operational plans and practices consistent with treatment technology employed in Plans B and C.

If there exists a preference for plans to meet Level II water quality, the key factors in the choice become (1) cost effectiveness in dollar terms, (2) chemical consumption, (3) recycling and multiple-purpose use of lands needed for treatment purposes, and (4) potential for restoration and revegetation of strip-mined lands. From the standpoint of residents of the Three Rivers Watershed, Plan C is the most cost effective in dollar terms. It costs $80,200,000 annually or $10,900,000 less than Plan B, the next more costly plan. In terms of chemical consumption, Plan C requires less than any other plan. On the other hand, it requires gaining access, through cooperative agreements with farmers and some purchase, to 175,000 acres of land; 28,000 acres in the study area and 147,000 acres in Northcentral Ohio. A total of 17,000 acres must be purchased, compared with the 3,000 acres required in Plans A-I and A-II.

In order to be able to initiate the implementation of Plan C by 1980, the latest time at which a decision on implementation will permit achievement of the 1985 goal of P.L. 92-500, study area residents must be willing to support early State assignment of high priority to cost-effective projects using land treatment technology to solve local pollution problems. These projects would be funded under the Federal EPA construction grant program. Other than the community of Bucyrus, which was mentioned before, some interest has been expressed in projects of this kind, during the public involvement and discussion of the alternatives, by the communities of Clyde and Willard.

Successful construction and operation of similar projects in the study area will do much to alleviate the concerns about land treatment expressed by study area residents. In this connection, Ohio State University and Bowling Green University have, during the course of the study, expressed interest in assisting communities in developing optimum management practices and adapting these practices for application and use throughout the State. This same point (that the more the public knows about a technology the more informed their choice will be) applies equally to advanced biological, physical-chemical, or land treatment.

There exists the potential in Plans A-I, A-II, and B, which, as shown in Table 44, is absent in Plan C, to restore and revegetate strip-mined lands in the Harrison County area of Southeastern Ohio. Plan C, on the other hand, includes provision for sludge recycling on agricultural land in the Three Rivers Watershed and in Northcentral Ohio rather than recycling on strip-mined lands in Southeastern Ohio. Although residents of the Three Rivers Watershed may be indifferent to where and in what manner sludge is recycled (except for cost considerations), it is worth noting that local organizations in Harrison County are already pursuing a program to restore and revegetate strip-mined land using waste treatment plant sludges.

C. Preference Sets for the Residents of Northcentral Ohio

Tables 45 contain preference sets for residents of Northcentral Ohio. The residents of Northcentral Ohio, particularly those residents and farmers dwelling on the land treatment area identified in Plan C, will experience significant impacts from the selection of Plan C from the alternative plans. For that reason, specific preference sets were developed to assist those residents in choosing among the four alternative plans. Since the direct impacts on the residents of Northcentral Ohio are essentially the same from Plans A-I, A-II and B, those alternatives are contained in the same preference set in Table 45.

The basis for choice by the residents of Northcentral Ohio among the alternative plans lies principally between continuation of current agricultural practices and community development in the absence of direct external influence and the potential for increasing farmer income and controlling the development of their communities by attracting industries and power plants that can use water supplies of the quality contained in the winter storage basins, while protecting prime farmland from urban development by committing it to spray irrigation.

D. Preference Sets for the Residents of the Rest of Ohio

Other than in their role as Federal taxpayers, the majority of the residents of Ohio outside the study area will experience little impact from the choice among alternative plans for wastewater management in the Three Rivers Watershed.

Table 46 contains preference sets for the remainder of the residents of Ohio. Those residents should not be concerned with cost effectiveness in dollar terms since, according to existing cost sharing policies, they contribute no specific proportion to the cost of implementing any plan that may be certified by the State of Ohio and approved by the Federal EPA. Because they do not contribute directly, they may prefer Plans A-II, B, or C over Plan A-I since the former meet Level II criteria at no extra cost to them.

Among Plans A-II, B, and C, they should prefer either B or C if they want to recycle nutrients and, between Plans B and C, they have the choice of either recycling sludge on strip-mined areas (Plan B) or on agricultural land (Plan C). If they prefer Plan C over Plan B, they must be willing to accept the transport of raw sewage to Northcentral Ohio and the anxieties of the affected farmers concerning change in their present crop patterns and management practices. If they prefer to meet Level II criteria and are interested in conserving chemicals, they should prefer Plan C, but if they are interested in conserving power, they should prefer Plan A-II. If they prefer that wastes from the Three Rivers

Watershed be treated in basin, they should prefer Plan A-II or B.

E. <u>Preference Sets for the Residents of the Rest of the United States</u>

From the standpoint of the residents of the rest of the United States, as shown in Table 47, the main bases for choice are cost-effectiveness in dollar terms, ability to meet the 1985 goal of PL 92-500, consumption of chemicals and electric power, and recycling.

The best plan in dollar terms from the standpoint of Federal taxpayers, is Plan A-I, which costs $24,500,000 annually less than Plan B, the next more costly plan. It is also the plan that requires the least amount of electric energy, 2,000 megawatt hours per day, or 480 megawatt hours per day less than Plan A-II. Therefore, Federal taxpayers should prefer Plan A-I provided they are willing to: (1) forego the opportunity to achieve the 1985 goal of PL 92-500, (2) forego the opportunity to employ wastewater treatment technologies that emphasize recycling of nutrients and other potentially valuable resources, and (3) increase consumption of chemicals by 90 tons per day over Plan C, the plan that consumes the least amount of chemicals. Since there already exists experience in various parts of the United States with each of the basin technologies, advanced biological, physical-chemical, and land treatment, Federal taxpayers understandably should be much less concerned with gaining additional experience with these technologies in the study area and in Ohio. Consequently, this item, which appears in the Preference sets for residents of the Three Rivers Watershed, North-central Ohio, and the rest of Ohio, is not shown in Table 47.

TABLE 44

PREFERENCE SETS FOR CHOICE AMONG ALTERNATIVE PLANS BY THE RESIDENTS OF THE THREE RIVERS WATERSHED

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PREFERENCE SET I

In Order to Choose Plan A
to Level I Over All Other Plans
Residents of the Three Rivers Watershed Must Prefer To:

1. Meet proposed State of Ohio Water Quality Standards and conform to the International Agreement on Great Lakes Water Quality;
2. Maintain the current institutional organization for wastewater treatment;
3. Avoid the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
4. Save study area taxpayers $10,700,000 annually over the cost of the most inexpensive plan to achieve Level Two;
5. Maintain, and possibly increase to 2,700 persons, (the most of any plan), employment levels in wastewater treatment;
6. Revegetate and restore 9,000 acres of barren strip-mined land, thereby increasing the productivity and aesthetic quality of those lands and local farm lands and increasing local property values; and
7. Consume 480 megawatt hours per day less power than the plan having the next lowest power consumption (2000 mwh/day, compared to 2480 mwh/day), and accept the consumption of natural resources to generate this power.

And Be Willing To:

1. Forego the opportunity to approach the 1985 water quality goals, as stated in PL 92-500;
2. Forego the opportunity to exploit the potential to increase farmer income through agricultural recycling of nutrients and water on 23,000 acres of land in the study area, and 118,000 acres of land in North Central Ohio, due to gains in productivity or reduced cost;
3. Forego the opportunity inherent in all the other plans to provide an additional increment of water quality, thereby retarding the rate of eutrophication in Lake Erie, maximizing the enhancement of commercial and sport fisheries, and water based recreation;
4. Forego the opportunity to create and maintain 28,000 acres of open space in the study area;
5. Accept anxiety concerning potential unrecovered losses[2] of urban families within the study area who reside on the 3,000 acres of urban lands that must be acquired in fee simple for wastewater and storm-water treatment facilities;
6. Consume 270 tons of chemical resources per day, and accept the consumption of the natural resources and power necessary to generate these chemical resources;
7. Forego the satisfaction of creating the potential for unconstrained utilization of water resources through application of the highest level of technology for wastewater treatment;
8. Allow Ohio stream quality standards to be violated in the Navigation Channel of the Cuyahoga River.
9. Be indifferent to the assignment by the State of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to cost-effective projects which will approach the 1985 goal in PL 92-500.

PREFERENCE SET II

In Order to Choose Plan A
to Level II Over All Other Plans
Residents of the Three Rivers Watershed Must Prefer To:

1. Obtain a substantial improvement in water quality consistent with the goals of PL92-500 and the Great Lakes Water Quality Agreement, thereby retarding the rate of eutrophication in Lake Erie, maximizing the enhancement of commercial and sport fisheries, and maximizing water based recreation;
2. Avoid the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
3. Slightly modify the current institutional organization for wastewater treatment to improve efficiency and permit regional coordination;
4. Revegetate and restore 10,000 acres of barren strip-mined land, thereby increasing the productivity and aesthetic quality of those lands and local farm lands, and increasing local property values;
5. Maintain, and possibly increase to 2,700 persons (the most of any plan), employment levels in wastewater treatment;
6. Consume the least amount of power (2480 megawatt hours per day), of any of the plans using the highest level of technology for wastewater treatment, and accept the consumption of natural resources to generate this power; and
7. Experience the satisfaction of creating the potential for unconstrained utilization of water resources through application of the highest level of technology for wastewater treatment;
8. Insure that the Ohio stream quality standards are met in the Navigation Channel of the Cuyahoga River.

And Be Willing To:

1. Increase study area costs $25,700,000 (from $69,500,000 to $95,200,000), annually over the most inexpensive alternative; 1/
2. Forego the opportunity to exploit the potential to increase farmer income through agricultural recycling of nutrients and water on 23,000 acres of study area lands and 118,000 acres in North Central Ohio due to gains in productivity or reduced costs;
3. Forego the opportunity to minimize chemical resource consumption by consuming 420 tons per day more chemical resources than the plan consuming the least amount (600 T/day, compared to 180 T/day), and accept the consumption of the natural resources and power necessary to generate these chemical resources;
4. Forego the opportunity to create or maintain 28,000 acres of open space to control or prevent urban sprawl;
5. Accept anxiety concerning potential unrecovered losses[2] of urban families within the study area who reside on the 3,000 acres of urban lands that must be acquired in fee simple for wastewater and stormwater treatment plant facilities;
6. Support early State assignment of high priority, for funding under the Federal Environmental Portection Agency construction grant program, to local cost-effective projects consistent with the overall plan.

PREFERENCE SET III

In Order to Choose Plan B
at Level II Over All Other Plans
Residents of the Three Rivers Watershed Must Prefer To:

1. Obtain a substantial improvement in water quality consistent with the goals of PL92-500 and the Great Lakes Water Quality Agreement, thereby retarding the rate of eutrophication in Lake Erie, maximizing the enhancement of commercial and sport fisheries and maximizing water based recreation;
2. Exploit the potential to increase farmer income through agricultural recycling of nutrients and water on 16,000 acres of land in the study area;
3. Revegetate and restore 10,000 acres of barren strip mined land, thereby increasing the productivity and aesthetic quality of those lands and local farm lands, and increasing local property values;
4. Preserve or create 20,000 acres of open space in the study area to help control or prevent urban sprawl; and
5. Experience the satisfaction of creating the potential for unconstrained utilization of water resources through application of the highest level of technology for wastewater treatment;
6. Insure that the Ohio stream quality standards are met in the Navigation Channel of the Cuyahoga River.

And Be Willing To:

1. Increase study area costs $21,600,000 (from $69,500,000 to $91,100,000), annually over the most inexpensive alternative; 1/
2. Accept the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
3. Make a slight modification to the current institutional framework to improve efficiency in operation and permit regional coordination;
4. Forego the opportunity to exploit the potential to increase farmer income through agricultural recycling of nutrients and water on the 118,000 acres of land in North Central Ohio, due to gains in productivity or reduced cost;
5. Forego the opportunity to minimize chemical resource consumption by consuming 290 tons of chemical resources per day more than the plan consuming the least amount (470 T/day, compared to 180 T/day), and accepting the consumption of natural resources and power necessary to generate these chemicals;
6. Forego the opportunity to minimize power consumption by consuming 1030 megawatt hours per day, more than the plan consuming the least amount of power (3030 mwh/day, compared to 2000 mwh/day), and accept the consumption of natural resources necessary to generate this power;
7. Forego the opportunity to maximize the increase in employment levels of wastewater treatment personnel by only providing for an increase to 2200 jobs (maximum of 2700 jobs);
8. Commit 16,000 acres of land in the study area to a long term lease, contract or easment, in order to acquire the necessary interest to assure successful water renovation;
9. Accept the installation of the necessary drains, irrigation hardware, and other capital improvements to the 16,000 acres in the study area;
10. Accept the anxiety concerning potential unrecovered losses[2] of urban and rural families within the study area residing on the 5000 acres of land that must be acquired in fee simple for wastewater and stormwater treatment facilities; and
11. Support early State assignment of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to local cost-effective projects consistent with the overall plan.

PREFERENCE SET IV

In Order to Choose
Plan C at Level II Over All Other Plans
Residents of the Three Rivers Watershed Must Prefer To:

1. Obtain a substantial improvement in water quality consistent with the goals of PL 92-500 and the Great Lakes Water Quality Agreement, thereby retarding the rate of eutrophication in Lake Erie, maximizing the enhancement of commercial and sport fisheries, and maximizing water based recreation;
2. Choose the least expensive plan for the study area taxpayers, consistent with the water quality goals identified in (1) above;
3. Exploit the potential to increase farmer income through agricultural recycling of nutrients and water on 23,000 acres of land in the study area, and 118,000 acres of land in North Central Ohio due to gains in productivity or reduced cost;
4. Use the least amount of chemical resources (180 tons per day), and accept the consumption of natural resources and power necessary to generate these chemicals;
5. Preserve or create at least 28,000 acres of open space in the study area and 147,000 acres of open space in North Central Ohio to help control or prevent urban sprawl;
6. Experience the satisfaction of creating the potential for unconstrained utilization of water resources through application of the highest level of technology fo[illegible]tewater treatment.
7. Insure that the Ohio Stream Quality Standards are met in the Navigation Channel of the Cuyahoga River.

And Be Willing To:

1. Increase study area costs $10,700,000 (from $69,500,000 to $80,200,000) annually over the most inexpensive alternative;
2. Accept the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
3. Make a very significant modification of the current institutional framework to permit substantial efficiencies in operation to be obtained from regionalization of wastewater treatment;
4. Forego the opportunity to revegetate and restore 10,000 acres of barren strip-mined land, thereby increasing the productivity and aesthetic quality of those lands and local farm lands and increasing local property values;
5. Forego the opportunity to maximize the increase in employment levels of wastewater treatment personnel by providing for 1,030 jobs less than the plan providing the most jobs (2,700, compared to 1,670);
6. Forego the opportunity to minimize power consumption by consuming the most amount of power (6,470 megawatt hours per day), of any of the plans using the highest level of technology for wastewater treatment and accept the consumption of natural resources necessary to generate this power;
7. Commit 28,000 acres of land in the study area and 147,000 acres of land in North Central Ohio to a long term lease, contract or easement in order to acquire the necessary interest to assure successful water renovation;
8. Accept the installation of the necessary drains, irrigation hardware and other capital improvements to the 23,000 acres in the study area, and the 118,000 acres in North Central Ohio.
9. Accept the anxiety concerning potential unrecovered losses[2] of urban and rural families within the study area residing on the 6,000 acres of land, and in North Central Ohio residing on the 14,000 acres of land that must be acquired in fee simple for wastewater and stormwater treatment facilities; and
10. Support early State assignment of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to local cost-effective projects utilizing technologies employed in this plan, thus allowing experience to contribute to a well-informed decision to adopt this plan by 1980, the latest time of choice to achieve the 1985 goal in PL 92-500.

1/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

2/ Potential unrecovered losses are generally considered to be any real or imaged losses in excess of full market value of land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

TABLE 45

PREFERENCE SETS FOR CHOICE AMONG ALTERNATIVE PLANS BY RESIDENTS OF NORTHCENTRAL OHIO 1/

PREFERENCE SET I

IN ORDER TO CHOOSE PLANS A-I, A-II or B OVER PLAN C A RESIDENT OF NORTHCENTRAL OHIO MUST PREFER TO:

1. Insure that all wastewater generated within the Three Rivers Watershed is treated within that Watershed, and not transported into Northcentral Ohio;

2. Maintain freedom of choice of crop patterns and farm management, without the external influence which is necessary for the efficient operation of the land treatment area to treat wastewater and grow crops;

3. Avoid the anxiety over potential unrecovered losses 2/ of urban and rural families in Northcentral Ohio who reside on the 14,000 acres of land that must be acquired in fee simple for aerated lagoons and winter storage basins;

4. Avoid the potential for occasional odors from aerated lagoons;

5. Avoid the anxiety of residential families and farmers over the potential for restricted community development resulting from commitment of lands for the land treatment of wastewater; and

6. Avoid the significant modification of the current local institutional framework, which is necessary to permit efficient operation of the multi-regional wastewater management system.

7. Avoid the potential for increased flooding, reduced aquatic habitat and increased sediment transport in the tributaries of the Vermilion, Huron, and Sandusky Rivers which would result from the transport of water from the Three Rivers Watershed:

8. Avoid irrigation of farmland at rates in excess of that quantity necessary for optimum crop production.

9. Avoid the transport of raw sewage after 1990 via tunnel from the Three Rivers Watershed Area to Northcentral Ohio.

AND BE WILLING TO:

1. Forego the opportunity to increase crop yields, and therefore farmer income, through agricultural recycling of nutrients and water on 118,000 acres;

2. Forego the opportunity to decrease farm production costs by obtaining the equivalent of as much as $60 per acre per year in fertilizer supplements through the application of the nutrients in wastewater to the land;

3. Forego the opportunity to prevent crop losses due to drought;

4. Forego the installation of the necessary underdrains, irrigation hardware and other capital improvements to the 118,000 acres of farmland, at no cost to the residents of Northcentral Ohio.

5. Forego the opportunity to encourage development of manufacturing and power industries which can use the quality of water supply contained in the winter storage basin.

6. Forego the opportunity to protect 172,000 acres of open space from urban sprawl.

7. Forego the sustained discharge of high quality water from the land treatment area into tributaries of the Vermilion, Huron and Sandusky Rivers.

PREFERENCE SET II

IN ORDER TO CHOOSE PLAN C OVER PLANS A-I, A-II OR B A RESIDENT OF NORTHCENTRAL OHIO MUST PREFER TO:

1. Exploit the opportunity to increase crop yields, and therefore farmer income, through agricultural recycling of nutrients and water on 118,000 acres;

2. Exploit the opportunity to decrease farm production costs by obtaining the equivalent of as much as $60 per acre per year in fertilizer supplements through the application of the nutrients in wastewater to the land;

3. Prevent crop losses due to drought.

4. Accept the installation of the necessary underdrains, irrigation hardware and other capital improvements to the 118,000 acres of farmland, at no cost to the residents of Northcentral Ohio.

5. Accept the potential for controlled development of manufacturing and power industries which can use the quality of water supply contained in the winter storage basins;

6. Exploit the opportunity to protect 172,000 acres of open space from urban sprawl; and

7. Accept the sustained discharge of high quality water from the land treatment area into tributaries of the Vermilion, Huron and Sandusky Rivers.

AND BE WILLING TO:

1. Accept wastewater from the Three Rivers Watershed for treatment on 118,000 acres of farmland in Northcentral Ohio;

2. Accept the significant modification of the current local institutional framework, which is necessary to permit efficient operation of the multi-regional Wastewater Management system.

3. Accept the modifications of crop patterns to those of fodder crops and external influence on farm management practice which is necessary for the efficient operation of the land treatment area to treat wastewater and produce crops;

4. Accept the significant modification of the current local institutional framework, which is necessary to permit efficient operation of the multi-regional wastewater management system.

5. Accept the anxiety over potential unrecovered losses 2/ of urban and rural families in Northcentral Ohio who reside on the 14,000 acres of land that must be acquired in fee simple for aerated lagoons and winter storage basins;

6. Accept the anxiety families and farmers over the potential for restricted community development resulting from commitment of lands for the land treatment of wastewater;

7. Accept the potential for occasional odors from aerated lagoons;

8. Accept the potential for increased flooding, reduced aquatic habitat and increased sediment transport in the tributaries of the Vermilion, Huron, and Sandusky Rivers which would result from the transport of water from the Three Rivers Watershed;

9. Accept irrigation water at 75 inches per year, which is in excess of that quantity necessary for optimum crop production.

10. Accept the transport of raw sewage after 1990 via tunnel from the Three Rivers Watershed Area to Northcentral Ohio.

1/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

2/ Potential unrecovered losses are generally considered to be any real or imaged losses in excess of full market value of land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

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TABLE 46

PREFERENCE SETS FOR CHOICE AMONG ALTERNATIVE PLANS BY THE RESIDENTS OF THE REST OF OHIO[1/]

PREFERENCE SET I

In Order to Choose
Plan A to Level I Over All Other Plans

A Resident of the Rest of Ohio Must Prefer To:

1. Allow the Three Rivers Watershed Area to meet proposed State of Ohio Water Quality Standards and conform to the International Agreement on Great Lakes Water Quality;
2. Have the Three Rivers Watershed treat all of its wastewater within the watershed;
3. Supply the necessary portion of the 2,000 megawatt hours per day consumed by this plan, thereby minimizing the contribution of the rest of Ohio;
4. Avoid the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
5. Insure that any anxiety concerning potential unrecovered losses[2] of urban families who reside on the urban lands that must be acquired in fee simple for wastewater and stormwater treatment facilities is confined to the Three Rivers Watershed.
6. Revegetate and restore 9000 acres of barren strip-mined lands, thereby increasing the productivity and aesthetic quality of those lands and local farm lands and increasing local property values.

And Be Willing To:

1. Specify that the Three Rivers Watershed forego the opportunity to approach the water quality goals as stated in PL 92-500;
2. Forego the opportunity to exploit the potential to increase farmer income through agricultural recycling of nutrients and water on 118,000 acres of land in North Central Ohio, due to gains in productivity or reduced cost;
3. Forego the opportunity inherent in all the other plans to provide an additional increment of water quality, thereby retarding the rate of eutrophication in Lake Erie, maximizing the enhancement of commercial and sport fisheries, and water based recreation;
4. Forego the opportunity to preserve and maintain, through the wastewater management program, open space in and around the Cleveland-Akron metropolitan area to control urban sprawl; and
5. Supply the necessary portion of the 270 tons of chemical resources per day consumed by this plan, and accept the consumption of the natural resources to generate these chemical resources.
6. Accept wastewater treatment plant sludges from the Three Rivers Watershed for revegetation and restoration of strip-mined lands and enrichment of local farm lands.
7. Allow Ohio stream quality standards to be violated in the Navigation Channel of the Cuyahoga River.
8. Be indifferent to the assignment by the State of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to cost-effective projects which will approach the 1985 goal in PL 92-500.

PREFERENCE SET II

In Order to Choose
Plan A to Level II Over All Other Plans

A Resident of the Rest of Ohio Must Prefer To:

1. Obtain a substantial improvement in water quality for the Three Rivers Watershed consistent with the goals of PL 92-500 and the Great Lakes Water Quality Agreement, thereby retarding the rate of eutrophication in Lake Erie, maximizing the enhancement of commercial and sport fisheries, and maximizing water based recreation;
2. Have the Three Rivers Watershed treat all of its wastewater within the watershed;
3. Revegetate and restore 10,000 acres of barren strip-mined land, thereby increasing the productivity and aesthetic quality of those lands and local farm lands and increasing local property values.
4. Supply the necessary portion of the 2,480 megawatt hours per day consumed by this plan, thereby minimizing the contribution of power from the rest of Ohio for any of the plans using the highest level of technology for wastewater treatment; and
5. Avoid the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
6. Insure that any anxiety concerning potential unrecovered losses[2] of urban families who reside on the urban lands that must be acquired in fee simple for wastewater and stormwater treatment plant facilities is confined to the Three Rivers Watershed.
7. Insure that the Ohio stream quality standards are met in the Navigation Channel of the Cuyahoga River.

And Be Willing To:

1. Forego the opportunity to exploit the potential to increase farmer income through agricultural recycling of nutrients and water on 118,000 acres in North Central Ohio due to gains in productivity or reduced cost;
2. Forego the opportunity to preserve and maintain through the wastewater management program, open space in and around the Cleveland-Akron Metropolitan area to control urban sprawl; and
3. Supply the necessary portion of the 600 tons of chemical resources per day consumed by this plan, the most of any of the four plans, and accept the consumption of the natural resources and power to generate these chemical resources.
4. Accept wastewater treatment plant sludges from the Three Rivers Watershed for revegetation and restoration of strip-mined lands and enrichment of local farm lands.
5. Support early State assignment of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to local cost-effective projects consistent with the overall plan.

PREFERENCE SET III

In Order to Choose
Plan B at Level II Over All Other Plans

A Resident of the Rest of Ohio Must Prefer To:

1. Obtain a substantial improvement in water quality for the Three Rivers Watershed consistent with the goals of PL 92-500 and the Great Lakes Water Quality Agreement, thereby retarding the rate of eutrophication in Lake Erie and maximizing the enhancement of commercial and sport fisheries, and maximizing water based recreation;
2. Have the Three Rivers Watershed treat all of its wastewater within the watershed;
3. Revegetate and restore at least 10,000 acres of barren strip-mined land, thereby increasing the productivity and aesthetic quality of those lands and local farm lands and increasing local property values;
4. Insure that any anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater is limited to the Three Rivers Watershed.
5. Insure that any anxiety concerning potential unrecovered losses2 of urban and rural families residing on the land that must be acquired in fee simple for wastewater and stormwater treatment facilities is limited to the Three Rivers Watershed.
6. Insure that the Ohio stream quality standards are met in the Navigation Channel of the Cuyahoga River; and
7. Preserve or create 20,000 acres of open space in and around the Cleveland-Akron Metropolitan Area to help control or prevent urban sprawl;

And Be Willing To:

1. Forego the opportunity to exploit the potential to increase farmer income, through agricultural recycling of nutrients and water on the 118,000 acres of land in North Central Ohio, due to gains in productivity or reduced cost;
2. Supply the necessary portion of the 470 tons of chemical resources per day and accept the consumption of the natural resources and power to generate these chemical resources;
3. Forego the opportunity to minimize power consumption by supplying the necessary portion of the 3,030 megawatt hours per day consumed by this plan, and accepting the consumption of the natural resources necessary to generate this power;
4. Accept wastewater treatment plant sludges from the Three Rivers Watershed for revegetation and restoration of strip-mined lands and enrichment of local farm lands.
5. Support early State assignment of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to local cost-effective projects consistent with the overall plan.

PREFERENCE SET IV

In Order to Choose
Plan C at Level II Over All Other Plans

A Resident of the Rest of Ohio Must Prefer To:

1. Obtain a substantial improvement in water quality for the Three Rivers Watershed consistent with the goals of PL 92-500 and the Great Lakes Water Quality Agreement, thereby retarding the rate of eutrophication in Lake Erie and maximizing the enhancement of commercial and sport fisheries, and maximizing water based recreation;
2. Exploit the potential to increase farmer income or government revenues through agricultural recycling of nutrients and water on 118,000 acres of land in North Central Ohio due to gains in productivity or reduced cost;
3. Supply the necessary portion of the 130 tons of chemical resources used per day, thereby minimizing the contribution of the rest of Ohio to any of the four plans, and accept the consumption of natural resources and power to generate these chemicals;
4. Accept the installation of the necessary under drains, irrigation hardware and other capital improvements to the 118,000 acres in North Central Ohio, financed by residents of the Three Rivers Watershed
5. Insure that the Ohio Stream Quality standards are met in the Navigation Channel of the Cuyahoga River.
6. Preserve or create at least 28,000 acres of open space in the study area and 147,000 acres of open space in North Central Ohio to help control or prevent urban sprawl;

And Be Willing To:

1. Accept wastewater from the Three Rivers Watershed for treatment on the land outside of the Watershed;
2. Forego the opportunity to revegetate and restore at least 9,000 acres per year of barren strip-mined land, thereby increasing the productivity and aesthetic value of those lands and local farm lands and increasing local property values;
3. Forego the opportunity to minimize power consumption by supplying the necessary portion of the largest amount of power consumed, 6,470 megawatt hours per day, of any of the four final plans, and accepting the consumption of the natural resources necessary to generate this power;
4. Commit 172,000 acres of land in North Central Ohio to a long term lease, contract or easement in order to acquire the necessary interest to assure continued agriculture and successful water renovation; and
5. Make a very significant modification of the current institutional framework to permit substantial efficiencies in operation to be obtained from regionalization of wastewater treatment.
6. Accept the anxiety concerning potential unrecovered losses[2] of urban and rural families in North Central Ohio residing on the 14,000 acres of land that must be acquired in fee simple for wastewater and stormwater treatment facilities; and
7. Accept the anxiety of residential families and farmers over the potential for restricted community development and farm management options resulting from specific use of lands for land treatment of wastewater;
8. Support early State assignment of high priority, for funding under the Federal Environmental Protection Agency construction grant program, to local cost-effective projects utilizing technologies employed in this plan, thus allowing experience to contribute to a well-informed decision to adopt this plan by 1980, the latest time of choice to achieve the 1985 goal in PL 92-500.

1/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

2/ Potential unrecovered losses are generally considered to be any real or imaged losses in excess of full market value of land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

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TABLE 47

PREFERENCE SETS FOR CHOICE AMONG ALTERNATIVE PLANS BY THE RESIDENTS OF THE REST OF THE UNITED STATES 1/

PREFERENCE SET I

In Order to Choose
Plan A to Level I Over All Other Plans

A Resident of the Rest of the United States Must Prefer To:

1. Allow the Three Rivers Watershed Area to meet proposed State of Ohio Water Quality Standards and conform to the International Agreement on Great Lakes Water Quality;
2. Save Federal taxpayers an average annual cost of $24,500,000 ($54,500,000 vs. $79,000,000) over the next most inexpensive plan, and use the savings to finance other high priority Federal problems; 1/
3. Use Federal tax monies to finance wastewater treatment technologies which have greater potential to increase job opportunities;
4. Avoid a potential increase in Federal taxpayer farm subsidy payments due to increased agricultural production farm crops grown on land treatment systems; and
5. Employ waste treatment technologies which emphasize recycling of sludges derived from wastewater consistent with the provisions of PL 92-500.

And Be Willing To:

1. Forego the opportunity to approach the water quality goals of PL 92-500, specifically the 1985 goal of elimination of discharge of pollutants;
2. Forego the opportunity to preserve and maintain, through the wastewater management program, open space in and around metropolitan areas against urban sprawl (there are a variety of reasons why he may wish to do this including indifference and the existence of other Federal programs which he may believe to be better suited for this purpose); and
3. Forego the opportunity to employ waste treatment technologies which emphasize recycling wastewater consistent with the provisions of PL 92-500.

PREFERENCE SET II

In Order to Choose
Plan A to Level II Over All Other Plans

A Resident of the Rest of the United States Must Prefer To:

1. Approach the water quality goals of PL 92-500, specifically the 1985 goal of elimination of discharge of pollutants;
2. Employ waste treatment technologies which emphasize recycling of sludges derived from wastewater consistent with the provisions of PL 92-500;
3. Use Federal tax monies to finance waste treatment technologies which have the greatest potential to increase job opportunities; and
4. Avoid a potential increase in Federal taxpayer farm subsidy payments due to increased agricultural production farm crops grown on land treatment systems.

And Be Willing To:

1. Increase Federal taxpayers average annual cost $3,700,000 (from $79,000,000 to $82,700,000) over the most inexpensive plan which approaches the water quality goals of PL 92-500; 1/
2. Forego the opportunity to employ waste treatment technologies which emphasize recycling of wastewater consistent with the provision of PL 92-500; and
3. Forego the opportunity to preserve and maintain, through the wastewater management program, open space in and around metropolitan areas against urban sprawl (there are a variety of reasons why he may wish to do this including indifference and the existence of other Federal programs which he may believe to be better suited for this purpose).

PREFERENCE SET III

In Order to Choose
Plan B at Level II Over All Other Plans

A Resident of the Rest of the United States Must Prefer To:

1. Approach the water quality goals of PL 92-500, specifically the 1985 goal of elimination of discharge of pollutants;
2. Preserve and maintain, through the wastewater management program, open space in and around metropolitan areas against urban sprawl;
3. Employ waste treatment technologies which emphasize recycling of wastewater consistent with the provisions of PL 92-500;
4. Employ waste treatment technologies which emphasize recycling of sludges derived from wastewater consistent with the provisions of PL 92-500; and
5. Minimize Federal taxpayer cost for a plan to approach the water quality goals of PL 92-500, average annual cost being $79,000,000. 1/

And Be Willing To:

1. Incur a potential increase in Federal taxpayer farm subsidy payments due to increased agricultural production from crops grown on land treatment systems; and
2. Believe that, or be indifferent as to whether payment of full market value of land and relocation assistance eliminates or minimizes potential unrecovered losses borne by owners of system required lands; and 2/
3. Use Federal tax monies to finance waste treatment technologies which have the potential --although to a somewhat lesser extent than do the other alternatives--to increase job opportunities.

PREFERENCE SET IV

In Order to Choose
Plan C at Level II Over All Other Plans

A Resident of the Rest of the United States Must Prefer To:

1. Approach the water quality goals of PL 92-500, specifically the 1985 goal of elimination of discharge of pollutants;
2. Preserve and maintain, through the wastewater management program, open space in and around metropolitan areas against urban sprawl;
3. Employ waste treatment technologies which emphasize recycling of wastewater consistent with the provisions of PL 92-500; and
4. Employ waste treatment technologies which emphasize recycling of sludges derived from wastewater consistent with the provisions of PL 92-500.

And Be Willing To:

1. Increase Dederal taxpayers average annual cost $1,200,000 (from $79,000,000 to $80,200,000), over the most inexpensive plan which approached the water quality goals of PL 92-500; 1/
2. Incur a potential increase in Federal taxpayer farm subsidy payments due to increased agricultural production from crops grown on land treatment systems;
3. Believe that, or be indifferent as to whether, payment of full market value of land and relocation assistance eliminates or minimizes potential unrecovered losses borne by owners of system required lands; and 2/
4. Use Federal tax monies to finance waste treatment technologies which have the potential--although to a somewhat lesser extent than do the other alternatives--to increase job opportunities.

1/ Assumes that the Federal taxpayers will finance 75% of the capital cost, and that the study area taxpayers will finance 25% of the capital cost, plus 100% of the operation and maintenance costs of any plan certified by the State of Ohio and approved for funding under the construction grant program by the Federal EPA; all costs over 50 years at 7% interest.

2/ Potential unrecovered losses are generally considered to be any real or imaged losses in excess of full market value of land and relocation assistance under the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

CHAPTER 9

CONCLUSIONS

A. Introduction

The summaries of the impacts of the four alternative plans displayed in the preference sets in Chapter 8 provide the preliminary basis for choice among the alternatives by various members of the public. Those sets include consideration of the public response to the components of the twelve alternatives. Additional impacts will probably be identified in the public review of the four alternative plans. The final report will include those impacts and others identified by the S[illegible] of Ohio in their review.

The preference sets provide data from which a number of conclusions can be drawn concerning future decisions. These conclusions are outlined in the following paragraphs. To insure that other principal characteristics of the four plans and their components are easily identified, they are highlighted in this concluding chapter.

B. Flexibility

These plans provide sufficient flexibility to allow for advances in technology and public attitudes. Plan A-I provides a direct comparison with Plan A-II for the decision between levels of treatment to be achieved in the future. In addition, Plan A-I provides the basis for implementation of a wastewater management system that achieves Level I, but can be modified to achieve Level II without

loss of the investment to achieve the former level.

In order to continuously progress toward the objectives established by PL 92-50C, choices among the plans must be made by specific dates. Those critical dates for decisions are shown pictorially in Figure 31.

Subsection 301 (b) (1) (B) of Public Law 92-500 requires publicly owned treatment works, in existence as of July 1, 1977, to achieve effluent limitations based upon secondary treatment. In order to complete construction of any required secondary treatment facilities by that date, a choice among plans must be made no later than 1975. The choice of secondary treatment by aerated lagoons prior to land treatment to reduce costs in the upper portion of the Watershed dictates the interim selection of Plan B or selection of Plan C. The decision to continue secondary treatment within the Watershed by activited sludge or physical-chemical treatment dictates the interim selection of Plan A-I. Selection of Plan A-II in 1975 is not necessary since Plan A-I is an intermediate stage of Plan A-II.

If the 1975 choice is early implementation of Plan C, that decision is final for both configuration and level of treatment, with the exception of those components utilizing advanced biological or physical-chemical treatment, which can be retained at Level I. Those components can be upgraded to Level II by a decision in 1980 in accordance with the 1985 goal of PL 92-500. Implementation of Plan C, beginning in 1975, using aerated lagoons would reduce the cost of that plan by an average of $16 million annually, for 50 years.

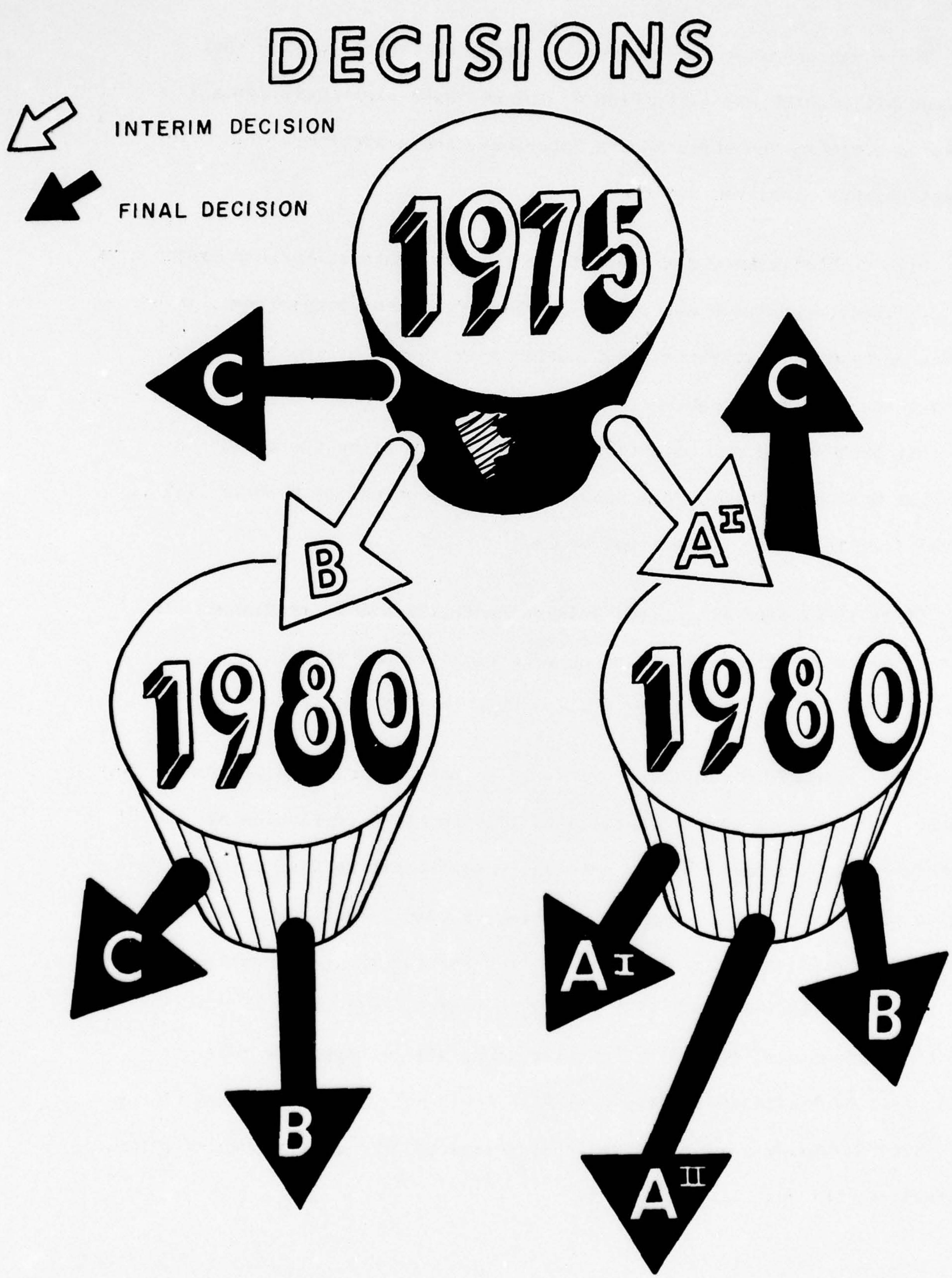
DECISIONS
INTERIM DECISION
FINAL DECISION
1975
C
C
B
A I
1980
1980
C
B
A I
B
A II

FIGURE 31

There are no major public concerns thus far expressed with the acceptability of Plan A-I or Plan B. Since those plans call for all treatment within the Three Rivers Watershed, there are no major institutional problems.

Plan C is currently unacceptable to the residents of Northcentral Ohio. Their opposition was expressed throughout the formulation stage and reaffirmed at the final public meetings. Sufficient experience with land treatment facilities to serve local communities in that area should not be anticipated by 1975 to allow the choice of Plan C at that time. That experience may be gained by 1980 if local facilities are operational by 1975.

If it is decided that Level I is adequate, Plan A-I, or Plan B, with Level I treatment in the advanced biological and physical-chemical treatment facilities, will provide that capability.

If it is decided that Level II is to be achieved, the selection among plans must be made no later than 1980 to allow completion of construction by 1985. This is especially applicable to Plan C to allow completion of the deep tunnel prior to 1985. With Plan B as the 1975 choice, the decision in 1980 lies between the continuation of Plan B or the evolution from Plan B to Plan C. With Plan A-I as the 1975 choice, the selection lies among direct upgrading to Plan A-II or evolution to Plan B or Plan C with activitated sludge or physical-chemical treatment preceding land treatment within the Watershed.

If Plan C is the 1980 choice, aerated lagoon secondary treatment in Northcentral Ohio will maximize cost effectiveness; however, secondary treatment within the Three Rivers Watershed prior to transport may be continued, with an increase in the cost of that plan by an average of $20 million annually, for 50 years.

Figure 32 identifies the average annual cost associated with each plan choice.

The residents of Northcentral Ohio currently oppose the implementation of Plan C in 1980. The concerns of those citizens with that plan are summarized in Table 48 and are discussed individually in Appendix VIII. The technical concerns may be resolved by experience of local communities using land treatment to resolve local water pollution control problems. However, present public attitudes not only include technical concerns but social acceptability concerns. Apparently, opposition to the plan is centered on the possible impact on existing farming practices and rural life style and to the transport of effluent from metropolitan areas into Northcentral Ohio for treatment, particularly if it is raw sewage.

Future attitudes of social acceptability of any plan cannot be predicted. However, changes in present attitudes regarding acceptability among the Northcentral Ohio citizens of any plan including land treatment components may be enhanced by preventing the disruption of existing rural community structures, agricultural practices, and crop patterns. Figure 33 symbolizes the probability of the acceptance of the plans by the residents of Northcentral Ohio.

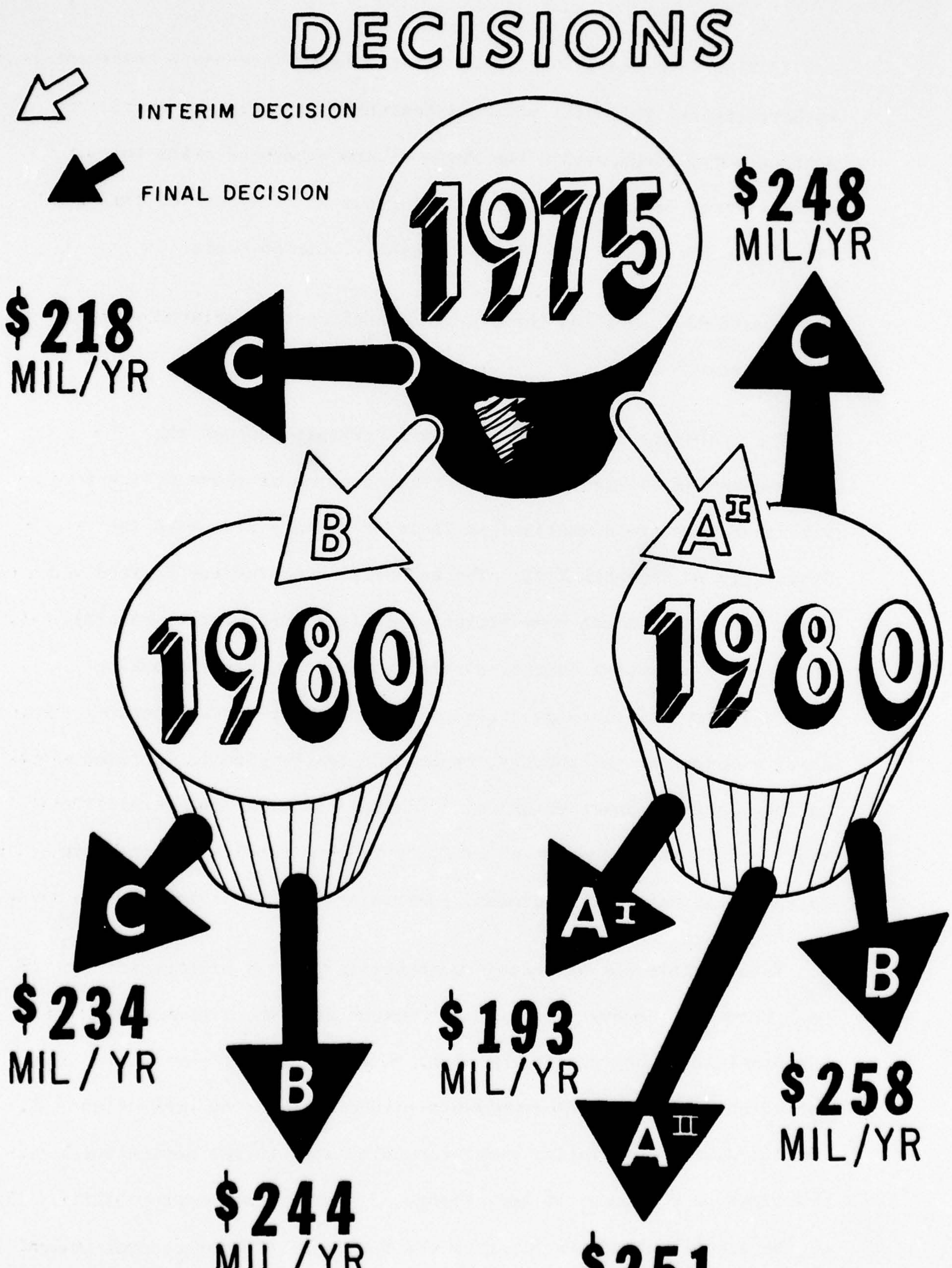
DECISIONS
INTERIM DECISION
FINAL DECISION
1975
$248 MIL/YR
C
$218 MIL/YR
C
B
A^{I}
1980
1980
C
$234 MIL/YR
B
$244 MIL/YR
A^{I}
$193 MIL/YR
A^{II}
$251 MIL/YR
B
$258 MIL/YR

FIGURE 32

TABLE 48
THE CONCERNS OF THE CITIZENS OF NORTHCENTRAL OHIO
REGARDING PLAN C*

INSTITUTIONAL

1. Potential loss of ownership of agricultural lands.

2. External control of the farming operations on privately owned lands.

HYDROLOGICAL

1. Flooding of local streams by return flow from irrigated lands.

2. Pollution of local groundwater resources.

SOCIAL

1. Transport of effluent from remote metropolitan areas.

2. Community disruption resulting from the location of the lagoons, storage basins, and irrigation areas in a single, massive site.

3. Potential odors and reduced treatment effectiveness from the aerated lagoons.

AGRICULTURAL

1. Contamination of soils by heavy metals.

2. Application rates greatly in excess of annual rainfall.

3. Extensive changes in farming practices necessary to insure adequate wastewater treatment.

*NOTE: A more complete description of these concerns appears in Appendix VIII.

DECISIONS

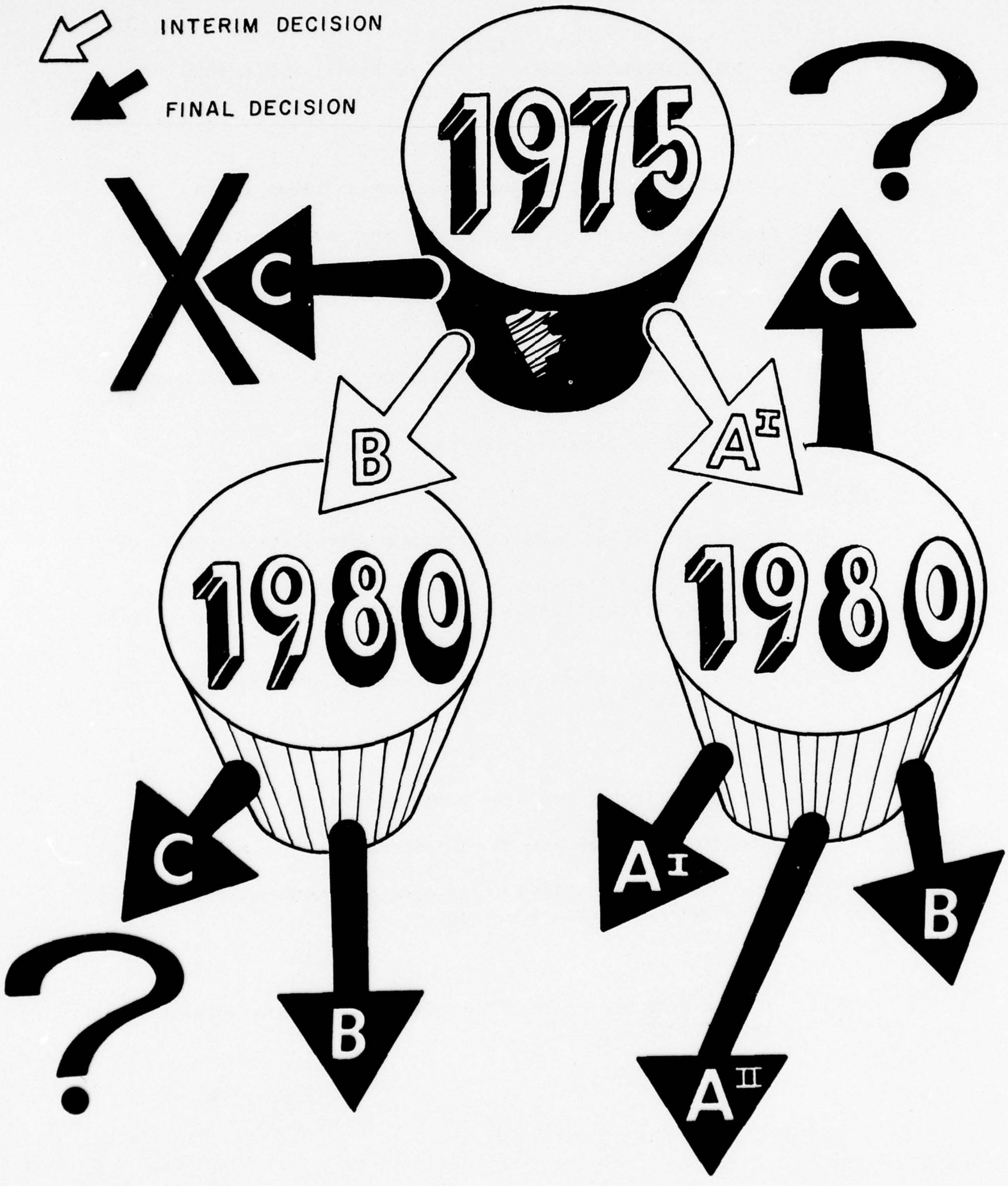

FIGURE 33

C. Industrial Treatment

Industrial wastewater treatment by Option 3, which includes sufficient pretreatment to insure compatibility with any technology, is incorporated into the three alternative plans designed to meet Level II criteria. Option 1 is incorporated into Plan A-I. However, if the practicability of extracting heavy metals by the soils without detriment to the soils, crops, or consumers is substantiated, Option 4 may be used in conjunction with the land treatment components of Plans B or C.

Option 2, which incorporates maximum industrial recycle, is compatible with any technology, and provides a substantial savings of wastewater treatment costs to the industries.

The final choice of industrial wastewater treatment option should be a cooperative decision of local officials and the industries.

D. Urban Stormwater Runoff

Stormwater is collected and treated in quantities sufficient to accommodate 97.3 percent of the total average annual urban stormwater runoff. Collecting and treating 99 percent would increase the cost by 30 percent while improving effectiveness by only 2 percent.

The decision to treat stormwater to Level I or to Level II is critical to the plan selection decisions. If Plan C is selected in 1975, Level II treatment is more cost effective, since land treatment accomplishes Level II treatment. If any other plan is

chosen in 1975, the decision as to Level II treatment of stormwater can be made in 1980 along with the selection among the plans. This allows time to monitor stream quality resulting from Level I treatment. If it is decided that Level I treatment of stormwater is adequate, significant savings can be achieved. This conclusion can affect the choice of plans in 1980.

E. Sludge Management

In order to conform to the current planning of the local officials, the phasing of all four plans includes incineration of sludge in Cleveland through 1990. A program is currently underway to upgrade the existing incinerator facilities there. The State must forego this plan if strip-mine application is the preferred option. The decision must be made now to save the cost of renovation of incinerators and apply those monies to the strip-mine restoration program. Further, in order to decide upon the restoration program, the State must obtain the rights-of-way and upgrade the pipeline between Cleveland and Harrison County and initiate institutional means of using the strip-mined lands.

F. Resource Requirements

The energy and chemical requirements for any of the four plans are increased over current consumption. This is also true of manpower needs to adequately operate the systems.

G. Incidental Benefits

Many incidental benefits are derived from each of the alternative plans. They include:

1. The nutrients applied to the soil in Northcentral Ohio through land treatment in Plan C have a fertilizer value of approximately $60 per acre per year.

2. A potential capital contribution from private industry in Plan C for a power plant site adjacent to the winter storage basin is estimated at $30 million.

3. All four plans provide flood control benefits in the Three Rivers Watershed area from the storage of stormwater for treatment, but potential cost savings have not be estimated.

4. The value of the strip-mined land in Southeastern Ohio will increase as a result of restoration and revegetation through the application of sludge in Plans A-I, A-II, and B. This increase has not been estimated.

H. Access to Lands for Treatment

Access to land necessary for the land treatment technology may be accomplished by several methods, including purchase, lease, easement, and cooperative agreements. Of these options, purchase is the least desirable. For example, if the land identified in Plan C were purchased by local or State government, $1.1 million annually would be removed from tax payments in the Northcentral Ohio counties concerned. Some other option is preferred. Management techniques should be worked out to allow the farmer and sanitary engineer to

use the same land. If changes in farm management are necessary to allow cooperative use of the land, appropriate management techniques should be developed cooperatively.

I. Institutional Aspects

The systems configured in Plans A-I, A-II, and Plan B can be managed by an existing governmental entity such as the Three Rivers Watershed District since the total system is within the basin. The District could be given the necessary authority and responsibility by appropriate State action to either monitor the compliance with the overall plan, with execution by local government, or be given total responsibility for execution.

Plan C presents a very difficult institutional problem since the configuration of the system defined by that plan encompasses many counties and many watersheds. This plan would call for State control or a special governmental agency to operate it.

Financially, the extent to which local and State institutions will be able to implement any alternative plan is highly contingent upon the ability of the Federal government to sustain over a long period of time the 75 percent contribution toward capital costs, and, to a lesser extent, upon the ability of local institutions to secure a contribution from industry toward capital and operation and maintenance costs.

The increased local wastewater expenditure suggested by the four plans can be accomplished without altering existing constitutional and statutory debt ceilings. Appendix VII contains the detailed institutional evaluation.

J. Implementation

Recognizing the limited full scale experience with any technologies considered for treatment to Level II criteria, early construction of local facilities would be advantageous for public acceptability and proper design of the facilities in any regional plan.

One principal public concern related to any of the three technologies centers around the proper operation and maintenance of wastewater treatment facilities to assure achievement of design performance. Other expressions of public concern include: 1) air pollution from sludge incinerators, 2) chemical requirements of physical-chemical facilities, 3) power requirements of all advanced treatment technologies, 4) the environmental impacts from the possible failure of large facilities, 5) inhibition of biological processes by toxic influents, and 6) the requirement for a large number of very highly trained operating personnel.

If projects are constructed prior to 1975, they can be monitored to obtain verification of the design criteria as well as measurement of the benefits achieved. This would insure that well-informed decisions are made at those critical dates previously identified and that the public concerns and engineering problems can be resolved in the design stage.

Early implementation and construction of components of the various plans would provide experience necessary for the decisions that must eventually be made by State and local officials in Ohio in choosing

from among the alternative plans and/or their components. Based on the public response from the workshops and public meetings and the planning needs of the Ohio Environmental Protection Agency, as documented in Attachment C, it can be concluded that the following types of programs are desired and needed:

1. Urban Stormwater Runoff Treatment.

   a. Treatment of runoff from a separately-sewered, densely-populated area of mixed residential and commercial development. Concrete basin storage would be provided with capacity optimized for combined treatment in municipal plants. Influent, effluent, rainfall, and runoff should be monitored.

   b. Treatment of runoff from a separately-sewered, moderately-populated area not in a metropolitan urban environment (a suburban residential area such as a smaller outlying city in rural surroundings). Earthern basin storage would be provided with treatment capacity to empty the basin within 30 days. Quantity and quality monitoring should be performed.

   c. Land treatment of runoff from a typical downtown urban area with ultimate treatment being provided at an urban park or other type of open space.

   d. Land treatment of runoff from a typical outlying residential area, with ultimate treatment being provided in parks, golf courses, or easily accessible agricultural lands.

2. Advanced Municipal Wastewater Treatment Plants.

   a. Physical-chemical treatment at a small plant with Level II capability.

b. Advanced biological treatment at a plant with Level I and Level II capability.

c. Land treatment at an in-basin site using the overland flow/infiltration method, at an in-basin site using spray irrigation, and at a site in the western land treatment area using spray irrigation with various land management techniques.

3. Storm Runoff Reduction by Urban Drainage Management.

Provide storm drains, on-site storage, parking-lot storage, roof-top storage, and other means of reducing the volume of storm runoff by various management methods.

4. Sludge Handling.

Show various ways to handle sludge, by application to agricultural land, strip mine land, and sanitary landfill, while monitoring leachate and surface runoff for various critical parameters. This project should not be implemented merely to dispose of sludges, but more importantly to accomplish restoration of unproductive land.

5. Water Monitoring System.

A water quality and flow monitoring system for the entire Three Rivers Basin Study Area. This system would measure the quality and quantity of the waters in the Three Rivers Watershed and allow monitoring of the effects of any treatment methods proposed. A similar monitoring system should be developed for water courses adjacent to land treatment sites outside the Three Rivers Watershed.

More detailed discussion of these early implementation programs is contained in Appendices III and V. Some of the public desires

concerning the types of programs are expressed in correspondence attached in Appendix VIII.

The execution of any plan or component thereof should be left to the decision of State and local governments and the public at large. The early implementation features identified above, or of any projects undertaken, should be fully coordinated with appropriate local, State, and Federal agencies.

In addition to these early implementation and construction features, other conclusions result from this study effort. A prerequisite of public involvement in wastewater treatment planning is education of the public in regard to treatment technologies, costs, and environmental effects. Also, basin-wide management plans should consider the results of this planning effort, the Northeast Ohio Water Development Plan, and other plans prepared by local, regional, State or Federal agencies for comprehensive water resource management.

The local governments and the citizens of Northcentral Ohio oppose Plan C. However, they have not excluded the land treatment technology from consideration for treating their own wastewater. The principal reasons for their opposition are the nonacceptance of effluent created in other basins or regions, the concern over changing farm methods and the design of a single massive land treatment area. The first concern cannot be eliminated without demonstrating benefits from acceptance of the effluent to offset any problems created. The other concerns can be eliminated by reducing the application rates sufficiently to allow

current farming practices and crop patterns to continue, and further, to design the land treatment system to use numerous dispersed sites rather than the one large area. These changes in Plan C would increase the cost of that plan to the extent that it would remain the least cost Level II plan, unless it is implemented by 1975. The environmental and social benefits resulting from these changes may well be worth the added dollar cost.

Final public meetings indicate that regardless of how Plan C is redesigned, the public in Northcentral Ohio will remain opposed to the transport of effluent into that watershed for land treatment from any area outside that watershed.

K. Assumptions and Projections

The assumptions and projections of data included in any planning study must be carefully monitored as the future unfolds. Changes in either the assumptions or projections will change portions of the plans. This is the major reason for providing a multiple means approach and for retaining flexibility for the decision process relating to wastewater management in the Three Rivers Watershed area.

CHAPTER 10

RECOMMENDATIONS

A. Introduction

The State of Ohio, especially through the Environmental Protection Agency and Department of Natural Resources, has played an active, central role in this study. Whenever possible, statewide as well as regional needs were met. The State and the local citizens it represents were the key to selecting the final plans. The following statement constitutes the position and recommendations of the State of Ohio, considering regional needs and the input from all sources, especially the local people affected by the various plans.

OhioEPA August 8, 1973

STATEMENT

by

DR. IRA L. WHITMAN, DIRECTOR

representing
The Ohio Environmental Protection Agency
The Ohio Department of Natural Resources

regarding the
Wastewater Management Study
For Cleveland-Akron and the
Three Rivers Watershed Areas

I appreciate the opportunity to comment on the Wastewater Management Study as it may affect the future of the resources and environmental quality of the State of Ohio. The Ohio Department of Natural Resources and the Ohio Environmental Protection Agency have cooperatively evaluated concepts proposed in this important report and my statement is intended to represent the joint conclusions of both departments.

In viewing the wastewater study in its entirety, we feel it is an unusually useful and well prepared report. We will make immeidate use of the information and conclusions presented during the perpetual updating and improvement of required basin and metropolitan water quality plans and in the formulation of sorely needed strip mine reclamation plans. Let me assure both the Corps and the Congress that this study will not be placed on the shelf and forgotten. The relevance and usefulness of the report was

greatly enhanced by the truly outstanding efforts by Colonel Moore and his staff to work in a close and sincere partnership with counterpart planners in state government. We thank Colonel Moore for this dynamic relationship and urge that other Corps Districts and Federal agencies emulate his example.

Despite my enthusiasm, however, it should not be assumed that we feel that all the relevant water quality questions have been answered.

In reviewing any wastewater management plan, and especially one of this magnitude and importance, the Ohio EPA must be constantly aware of the plan's relationship to Public Law 92-500, passed October 1972, and to our national problems of energy resources. This plan considers both of these factors in making its final recommendations. The policy of the State of Ohio is to pursue the goal of Public Law 92-500, that is the elimination of the discharge of pollutants to the navigable waters by 1985, by making optimum use of all the resources available to us and minimizing waste.

The plan proposes four alternative strategies for wastewater management and requests that the state make the final plan recommendation. This is consistent with water quality planning requirements of the Federal EPA, and with the desires of the state.

The State of Ohio will consider Alternates A_1, A_2 and B for recommendations after receiving comments from the public and consultations with the U. S. Environmental Protection Agency. At this time the State of Ohio will not consider Alternative C, that of the transport of wastewater for land treatment in North Central Ohio, as one of the viable alternatives, unless the public in the Three Rivers Watershed area and the North Central area requests the state to consider it among the alternatives.

We are all aware that the most widely discussed aspects of the Wastewater Management Study are its proposals for land disposal of treated sewage. There is nothing new, of course, in this concept. Spray disposal or broad irrigation of various industrial wastes has been practices for many years in Ohio with reasonable success. After reviewing the Corps study, I believe I would have little hesitation in reviewing proposals for land disposal of adequately treated wastes from communities of less than 100,000 population in the same way I would review any other waste treatment plant design. Every plant design must pass rigid examination by Ohio EPA for effectiveness, cost, safety, and operability. It is true, however, that there is a significant difference between land disposal of industrial wastes on small fields owned by the industry and land disposal of sanitary wastes on larger land areas. We would be interested in seeing this concept utilized by one or more communities of less than 100,000 population both in the Sandusky Watershed and the Three Rivers

Watershed. We would be particularly interested in innovative attempts to make positive economic utilization of the liquids being disposed of for improved agricultural returns and land reclamation. Special and detailed quality monitoring of the runoff, the soil, and the crops produced would be required. We are concerned about land disposal over large areas, where institutional and political problems would outweigh technical considerations. And, transfers of water from basin to basin need to be subjected to particularly harsh scrutiny - for hydrologic and social reasons alike.

Depositing sludge on land areas as a means of disposal is a generally worthwhile concept and this may be especially true for strip mined areas in Ohio where sludge may also aid in their restoration. The State of Ohio wishes to give support to proposals utilizing sludges for strip mined land reclamation and proposes that a first year trial of sludge disposal in Harrison County be pursued, based upon local acceptance.

The Ohio EPA in consultation with interested parties designated a committee including OEPA, ODNR, Cleveland Regional Sewer District, Harrison County, Coshocton County, OSU and Case Western Reserve to study the transfer of Cleveland sludge to strip mined areas and submit these recommendations to the state. I will ask the committee to study the proposal to transfer Cleveland's sludge for one year to strip mined areas.

As we view water quality and resource planning needs in Northern Ohio, I feel that a vital area has thus far been omitted: that is the potential impact on Lake Erie of these and other water management alternatives. There is an urgent need for a comprehensive Lake Erie water quality management plan. Lake Erie is the recipient of the runoff and the wastes and the sediments from one of the most complex urban, industrial and agricultural areas in the world, yet we possess only a very limited knowledge of the dynamics of this vast body of water. To meet this need, we urge that Section 108 of PL 92-500 be immediately funded in the full amount authorized and that the study be conducted by the U. S. Army Corps of Engineers in a realistic partnership with Canada and the States of Ohio, Michigan, Pennsylvania and New York. Ohio stands ready and eager to participate in this study.

In conclusion, I again wish to thank the Corps for this useful report. I would also urge members of the public and their governmental agencies at all levels to communicate with us regarding the foregoing concepts. If we are to meet the high environmental goals set by the public, we must work together to utilize every available scientific technique. We look forward to a long and continued working relationship between the people of Ohio and the outstanding staff of the Buffalo District Office of the Corps of Engineers.

ATTACHMENT A

LIBRARIES HAVING FULL DRAFT REPORT

Libraries Having Full Draft Report

A **full** set of the draft report is available for public review at the following libraries in Ohio.

City	Library
Akron	Akron Public Library (Main) 55 S. Main Street
	East Branch 60 Goodyear Blvd.
	Maple Valley Branch 1293 Copley Road
	North Branch 183 E. Cuyahoga Falls Avenue
	University of Akron Library 302 E. Butchel Avenue
Ashland	Ashland Public Library 224 Claremont Avenue
Attica	Attica Public Library North Main Street
Avery	Ehove Joint Vocational School Library Route 250
Barberton	Barberton Public Library Park and Fifth Streets
Bedford	County Library-Bedford 155 Warrensville Center Road
Berea	Berea Branch Library 1 Tract Street
	Ritter Library Baldwin Wallace College
Bellevue	Bellevue Public Library 224 E. Main Street

City	Library
Bucyrus	Bucyrus Public Library 200 E. Mansfield
Burton	Burton Public Library
Cadiz	Cadiz Public Library Court House
Canton	Canton Public Library 236 Third Street S.W.
Chagrin Falls	Chagrin Falls Public Library 100 E. Orange
Chardon	Geauga County Public Library 108 S. Hambden Street
Cleveland	Cleveland Public Library 325 Superior Avenue (Main)
	Carnegie West Branch 1900 Fulton Road
	Euclid 100th Street Branch 9917 Euclid Avenue
	55th East Branch 5510 Superior Avenue
	Harvard-Lee Branch 4125 Lee Road
	Lorain Branch 8216 Lorain Avenue
	Miles Park Branch Miles Park and E. 93rd Street
	Nottingham Branch 760 E. 185th Street
	South Brooklyn Branch Corner Pearl Road & Henritz
	West Park Branch 3805 W. 157th Street

City	Library
Cleveland	Cleveland Heights-University Heights Public Library 2345 Lee Road
	Grasselli Library John Carroll University North Park and Miramar
	Freiberger Library Case Western Reserve University 11161 East Blvd.
	Cuyahoga Community College Library Metropolitan Campus 2900 Community College
Columbus	Ohio State University Library 1858 Neil Avenue
Crestline	Crestline Public Library W. Bucyrus Street
Cuyahoga Falls	Taylor Memorial Public Library Third Street and Broad Blvd.
Euclid	Euclid Public Library 631 E. 222nd Street
Elyria	Elyria Public Library 320 Washington Ave.
Fremont	Birchard Public Library Sandusky County 423 Croghan Street
Galion	Galion Public Library Association 123 North Market Street
Green Springs	Memorial Library North Broadway Street
Hudson	Hudson Library and Historical Society 22 Aurora Street
Hiram	Portage City District Library 6813 Wakefield Road
	Teachout-Price Memorial Library Hiram College
Huron	Bowling Green State Universtiy Fireland Campus Library 901 Rye Beach Road

City	Library
Kent	Kent Free Library 312 W. Main Street
	Kent State University Kent State University Library
Kirtland	Kirtland Public Library 9189 Chillicothe Rd.
Lakewood	Lakewood Public Library 15425 Detroit Avenue
Mansfield	Mansfield Campus Library Ohio State University 2375 Springmill
	Mansfield Public Library 43 W. Third Avenue
Maple Heights	Maple Heights Regional Library 15901 Libby Road
Medina	Franklin Sylvester Library 210 S. Broadway
Mentor	Mentor Public Library 8215 Mentor Avenue
Milan	Milan Public Library Church Street
Monroeville	Monroeville Public Library 34 Monroe Street
New London	New London Public Library 67 S. Main Street
Norwalk	Norwalk Public Library 46 W. Main Street
Oberlin	Carnegie Library Oberlin College
Painesville	Morley Library 184 Phelps Street

City	Library
Parma	Cuyahoga Community College Library 7300 York Road
Peninsula	Peninsula Library 6105 River View Road
Ravenna	Reed Memorial Library 167 E. Main Street
Rocky River	Rocky River Public Library 19875 Riverview Avenue
Sandusky	Library Association of Sandusky Corner of Columbus Avenue & W. Adams
Shelby	Marvin Memorial Library 34 N. Gamble Street
Sycamore	Sycamore Community Library E. Seventh Street
Shaker Heights	Shaker Heights Public Library 3450 Lee Road
Stow	Stow Public Library 3512 Darrow Road
Tiffin	Beeghly Library Heidleberg College
	Tiffin-Seneca Public Library 108 Jefferson Street
	Tiffin University Library 139 Miami Street
Twinsburg	Twinsburg Public Library 9840 Ravena Road
Upper Sandusky	Carnegie Public Library
Wadsworth	Ella M. Everhard Public Library 132 Broad Street
Westlake	Porter Public Library 27054 Center Ridge Road

City	Library
Willard	Willard Memorial Library 6 W. Emarld Street
Willoughby	Willoughby Public Library 38129 Euclid Avenue
Willowick	Willowick Public Library 263 East 305th Street
Wooster	Wayne County Public Library 304 N. Market Street

ATTACHMENT B

OHIO STREAM-WATER QUALITY CRITERIA - 1972

WATER POLLUTION CONTROL BOARD
OHIO DEPARTMENT OF HEALTH
COLUMBUS, OHIO

RESOLUTION ESTABLISHING AMENDED CRITERIA OF STREAM-WATER QUALITY FOR VARIOUS USES ADOPTED BY THE BOARD ON MARCH 14, 1972

WHEREAS, Section 6111.03, of the Ohio Revised Code, provides, in part, as follows:

"The water pollution control board shall have power:

(A) To develop programs for the prevention, control and abatement of new or existing pollution of the waters of the state; ...." and

WHEREAS, Primary indicators of stream-water quality are needed as guides for appraising the suitability of surface waters in Ohio for various uses; and

WHEREAS, The stream-water quality criteria for various uses and minimum conditions applicable to all waters adopted by the Board on June 14, 1966, have been amended by the Ohio River Valley Water Sanitation Commission; and

WHEREAS, The criteria adopted by the Board on October 10, 1967, have been further amended by the Ohio River Valley Water Sanitation Commission; and

WHEREAS, The Environmental Protection Agency in a letter dated January 18, 1971, on reviewing the criteria adopted by the Board April 14, 1970, recommended certain changes and additions to the criteria.

THEREFORE BE IT RESOLVED, that the following amended stream-water quality criteria for various uses, and minimum conditions applicable to all waters, and policies for protection of high quality waters and for water quality design flow, are hereby adopted in accordance with amendments of the Ohio River Valley Water Sanitation Commission, and the recommendations of the Environmental Protection Agency.

AND BE IT FURTHER RESOLVED, That the amended stream-water quality criteria for various uses, for minimum conditions, for protection of high quality waters, and, for water quality design flow, be made applicable to the following waters of the state:

1. Maumee, Tiffin, St. Joseph, and St. Marys River Basins:
2. Great Miami, Whitewater, and Wabash River Basins:
3. Ashtabula River, Conneaut and Turkey Creeks:

4. Ohio River of Ohio-West Virginia and Ohio-Kentucky;
5. North Central Ohio Tributaries of Lake Erie;
6. Scioto River Basin;
7. Little Miami River Basin;
8. Rocky, Cuyahoga, Chagrin, and Grand River Basins;
9. Muskingum River Basin;
10. Hocking River Basin.

MINIMUM CONDITIONS APPLICABLE TO ALL WATERS AT ALL PLACES AND AT ALL TIMES

1. Free from substances attributable to municipal, industrial, or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices in concentrations or combinations which are toxic or harmful to terrestrial and aquatic life.

PROTECTION OF HIGH QUALITY WATERS

Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at their existing high quality, pursuant to the Ohio water pollution control statues, so as not to interfere with or become injurious to any assigned uses made of, or presently possible, in such waters. This will require that any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required, as part of the initial project design, to provide the most effective waste treatment available under existing technology. The Ohio Water Pollution Control Board will cooperate with other agencies of the state, agencies of other states, interstate agencies and the Federal Government in the enforcement of this policy.

WATER QUALITY DESIGN FLOW

Where applicable for the determination of treatment requirements the water quality design flow shall be the minimum seven consecutive day average that is exceeded in 90 percent of the years.

STREAM-QUALITY CRITERIA

FOR PUBLIC WATER SUPPLY

The following criteria are for evaluation of stream quality at the point at which water is withdrawn for treatment and distribution as a potable supply:

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.

2. Threshold-odor number: Not to exceed 24 (at 60 deg. C.) as a daily average.

3. Dissolved solids: Not to exceed 500 mg/l as a monthly average value, not exceed 750 mg/l at any time.

4. Radioactivity: Gross beta activity not to exceed 1,000 picocuries per liter (pCi/l), nor shall activity from dissolved strontium 90 exceed 10 pCi/l, nor shall activity from dissolved alpha emitters exceed 3 pCi/l.

5. Chemical constituents: Not to exceed the following specified concentrations at any time.

Constituent	Concentration (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (hexavalent)	0.05
Cyanide	0.025
Fluoride	1.0
Lead	0.05
Selenium	0.01
Silver	0.05
Mercury	0.005

6. In addition: Waters designated as a source of public water supply will be of such quality that Federal drinking water standards for finished water can be met by conventional treatment which includes coagulation, filtration and disinfection.

FOR INDUSTRIAL WATER SUPPLY

The following criteria are applicable to stream water at the point at which the water is withdrawn for use for industrial cooling and processing:

Dissolved solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time.

FOR AQUATIC LIFE - WARM WATER FISHERIES

The following criteria are for evaluation of conditions for the maintenance of a well-balanced, warm-water fish population. They are applicable at any point in the stream except for areas necessary for the admixture of waste effluents with stream water:

1. Dissolved oxygen: Not less than an average of 5.0 mg/l per calendar day and not less than 4.0 mg/l at any time.

   Variance: For the navigation channel of the Cuyahoga River the minimum dissolved oxygen concentration during stagnant low flow periods is 3.0 mg/l until such time as means or procedures have been developed to permit attainment of higher dissolved oxygen levels.

2. pH:

   A. No values below 6.0 nor above 8.5.

   B. Daily fluctuations which exceed the range of pH 6.0 to pH 8.5 and are correlated with photosynthetic activity may be tolerated.

3. Temperature:

   A. No abnormal temperature changes that may affect aquatic life unless caused by natural conditions.

   B. The normal daily and seasonal temperature fluctuations that exist due to natural causes shall be maintained within acceptable limits.

   C. Maximum temperature rise at any time or place above natural temperatures shall not exceed 5 deg. F. In addition, the water temperature shall not exceed the maximum limits indicated in the following table.

	Maximum Temperature in Deg. F. During Month											
WATERS	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
All waters except Ohio River	50	50	60	70	80	90	90	90	90	78	70	57
Main Stem-OhioRiver	50	50	60	70	80	87	89	89	87	78	70	57

4. Toxic substances: Not to exceed one-tenth of the 96-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

FOR AQUATIC LIFE - COLD WATER FISHERIES

The following criteria are for evaluation of conditions for the maintenance of aquatic life - cold water fisheries population. They are applicable at any point in the stream except for areas necessary for the admixture of sewage effulents with stream water:

1. Dissolved oxygen: Not less than 6 mg/l at any time and not less than 7 mg/l at any time in spawning areas.

2. pH: No values below 6.5 nor above 8.5.

3. Temperature: Natural stream temperatures. No heat to be added.

4. Toxic substances: Not to exceed one-tenth of the 96-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

These criteria are to be applied to the following streams or sections thereof in accordance with the following classifications of the Division of Wildlife. Ohio Department of Nautral Resources:

A. Year-round Cold Fishery.

   1. Mad River and its tributaries (upstream of Urbana)*.
   2. Beaver Creek located in Seneca County.
   3. Cold Creek located in Erie County.

B. Seasonal Cold Water Fishery**.

   1. Pine Run located in Ashland County.
   2. Turkey Creek located in Ashtabula County*.
   3. Conneaut Creek located in Ashtabula County*.
   4. East Branch, Chagrin River located in Geauga County.
   5. Apple Creek located in Wayne County.
   6. North Fork of Little Beaver Creek located in Columbiana County*.
   7. Little Pickerel Creek located in Sandusky County.
   8. Cross Creek located in Jefferson County.

* - Interstate streams or tributaries thereto.

** - These streams on occasion may not meet the cold water fisheries criteria for dissolved oxygen during hot weather drought flow conditions.

FOR RECREATION

The following criteria are for evaluation of conditions at any point in waters designated to be used for recreational purposes:

PRIMARY CONTACT - (SWIMMING AND WATER-SKIING)

Bacteria: The fecal coliform content (either MPN or MF count) not to exceed 200 per 100 ml as a monthly geometric mean based on not less than five samples per month; nor exceed 400 per 100 ml in more than ten percent of all samples taken during a month.

SECONDARY CONTACT - (BOATING, FISHING AND WADING)

Bacteria: The fecal coliform content (either MPN or MF count) not to exceed 1,000 per 100 ml as a monthly geometric mean based on not less than five samples per month; nor exceed 2,000 per 100 ml in more than ten percent of all samples taken during a month.

FOR AGRICULTURAL USE AND STOCK WATERING

Waters used for agricultural use and stock watering shall meet the minimum conditions applicable to all waters (four freedoms).

ATTACHMENT C

RECOMMENDATIONS FROM THE OHIO ENVIRONMENTAL PROTECTION AGENCY

State of Ohi 'vironmental Protection Agency. Box 118, 450 E--' Town Street, Columbus, Ohio 43216-(614) 469-3543

December 5, 1972

Colonel Robert Moore
Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

John J. Gilligan
Governor
Dr. Ira L. Whitman
Director

Dear Colonel Moore:

We have reviewed with considerable interest the waste management alternatives developed as part of the Cuyahoga Wastewater Management Plan. The analysis of environmental effects of each alternative is equally interesting, although I wish it had been possible to specifically relate the alternatives to the environment as well as to each other. Inasmuch as we anticipate utilizing this data to assist in evaluating waste and resource management strategies to be recommended in the state's basin and metropolitan water quality plans, I feel it appropriate to respond to you in terms of our own planning needs as they relate to the subject of your study. You may then find it possible and desirable to expand upon the data presented in various of the alternatives, to the extent that time and funds are available.

It should also be made clear in the plan that none of the alternative strategies proposed should be carried out by the direct federal implementation or action until proven practical and desirable by suitable demonstration projects in the geographic area covered by the report.

Among our planning needs which could tremendously benefit from the Cuyahoga Wastewater Management Plan, we would particularly include the following:

A. Update the state's Northeast Ohio Water Plan to reflect anticipated federal standards and the treatment of urban storm runoff.

B. Recognizing that disposal of treated wastewater directly into streams and lakes is not necessarily the best resource management strategy, we are greatly interested in cost-effectiveness of disposing treated wastewater and sludge on land. Existing population distribution in the Three Rivers area suggests that land disposal be considered in terms of two strategies: a) maximum local management with disposal of as much wastewater as possible within the basin of origin and exportation of the balance (such as your alternative 7) and, as an interim step, alternative 5, or b) maximum logical regionalization of land disposal such as contemplated in your alternatives 4 and 12, or more practically, alternative 8.

C. Disposal of sewage sludge and fly ash was not seriously broached in the Northeast Plan. Thorough analysis and recommendations on this matter are a must for any waste management alternative considered. Utilization of these resources for strip mine area reclamation should be considered only one of several possibilities since, if successful, "competition" could result.

D. To demonstrate to ourselves and the public the potential utility of the newer strategies discussed above, it seems urgent that several early action demonstration projects be proposed prior to any major implementation works. Demonstration projects should be practical solutions to existing local needs and be compatible potential components of the fully implemented total scheme if they prove successful. Recommendations could well include:

1) Implementation details on several actual communities which could profit by land disposal systems during the next five years. Consider towns in the Upper Cuyahoga and in the potential wastewater export areas.

2) Same approach for demonstration of physical-chemical systems in a small residential community and a mixed industrial city.

3) Same approach for demonstration of sewage sludge/fly ash utilization for strip mine or dense clay area land reclamation. Project should be of operational scope rather than laboratory demonstration.

4) Urban storm runoff treatment demonstration in a large city.

I would also like to note that we are becoming increasingly concerned regarding the wise allocation of the land and energy available to us in Ohio.

We feel it wise to allocate some of these resources to waste treatment. But we are most concerned that ultimate plan studies such as yours consider the break-even points where space and energy requirements for environmental cleanup will begin to worsen rather than improve the environment. The tentative warnings of the KSU evaluation must be thoroughly examined.

Let me suggest several constraints which we feel should apply to all alternatives considered: a) Return of sewage sludge for soil improvement should be costed; b) Total land, energy, chemical and dollar resources should be clearly shown; c) Potential flow regime changes (quantity and quality) should be estimated in detail for each affected stream; d) Legal aspects should be considered including effects on riparian rights vs. reasonable use doctrine, Akron "ownership" of the flows of the Cuyahoga, public expense to benefit private land, etc.; e) Each alternative studied should be related to established stream standards and the plan should show the range of water quality enabled by each alternative as well as presenting estimates of added biotic species anticipated as a result of increasing investment;
f) Any acceptable basin plan must include estimated water quality effects of sedimentation and of its control. We cannot adopt any "alternative" until this data is available; g) No alternative or plan is complete until it spells out the methods of implementation from institutional and financial points of view and our acceptance of any alternative would, of course, be geared to this.

My staff will be pleased and available to discuss the above concepts in detail as may seem helpful to you. I do also want to personally recognize and thank you for the wonderfully cooperative and helpful spirit which has developed between our respective planning staffs during the conduct of this study. I am taking the liberty of including a copy of a recent letter from George Watkins because I feel his concerns are well taken and may be helpful to you.

Sincerely,

Ira L Whitman

Ira L. Whitman, Ph.D.
Director

ILW/drh

Enclosure (1)

THREE RIVERS WATERSHED DISTRICT

621 ~~1917~~ SUPERIOR BUILDING

CLEVELAND, OHIO 44114

Telephone: 621-1126

November 27, 1972

Dr. Ira L. Whitman, Director
Ohio Environmental Protection Agency
450 East Town Street
Columbus, Ohio 43216

BEST AVAILABLE COPY

Dear Ira:

It was thoughtful of you to ask me to the State's discussion of the Corps' studies on wastewater management in the District. In response to your request, I am putting down my thoughts at this point in the planning process in which we are involved with the Corps.

It seems to me important to keep our objectives in mind so we do not get carried away by persuasive arguments related only to waste management techniques.

Concerns about liquid waste management have arisen because our waterways and lakes have been used as waste sinks to the point that other uses have been reduced or eliminated. Many adverse effects in our waters have been attributed to pollution from such waste discharges. Some of these effects have had little scientific evidence presented to support the case that such waste discharges were in fact the cause of the noted undesirable effects.

It is beginning to appear, for example, that the decline in the Lake Erie fisheries is related more to reduction in suitable spawning environments and to predatory fishing practice than to waste discharges. This suggests that if one objective is to restore commercial fisheries in the Lake attention to sedimentation instreams, Lake shore erosion, dam elimination, and improved commercial fish management is important and in most areas probably more important than one-sided correction of effluent discharged from pipes.

Thus it was that we started with concern about <u>uses</u> of our waters. Water quality objectives established to meet this concern include:

protection of public water supplies
restoration of fish habitats and fisheries in streams and Lake Erie
restoration of shore waters and streams for water contact sports
restoration of the aesthetic quality of streams and other waters

As planning has gone forward certain other objectives have been derived, particularly those which relate to use of wastes for beneficial purposes wholly apart from water quality. Thus use of sludge as a soil builder and use of nutrients in waste water streams for crop production have been derived.

Another set of objectives has been derived largely from administrative difficulties in translating water uses into waste treatment standards for pipe discharges, namely uniform effluent quality standards.

My principal technical concern with the Corps study is that ITS GOALS are essentially all of the derived variety. The principal exception to this - and a valuable addition to earlier planning studies, ours included, - is their broader examination of techniques for control and treatment of urban runoff.

Because of their goal derivation, it is not possible to determine whether OUR goals will be reached even when we meet their goals. The MSU evaluators, for example, were able only to put into relative terms the impacts on receiving waters of water quality effluents produced by their various alternatives.

Thus it seems to me we need from the Corps specific information so we may judge how well our goals are likely to be met. We need this so the public may determine the best way to balance the very major expenditures they are going to have to make and to have some assurance that the goals they have supported are going to be reached.

Specifically this means to me that there should be a demonstration that the very significant annual expenditure differences between existing planning targets result in significant differences in the quality of the environment we are going to achieve. I would start with the N. E. Ohio Water Development Plan as the base (although we are not at that level of achievement yet, it was designed to achieve the designated uses of our waters) and proceed to the Corps "NEOWDP" level 1 plan and thence to a level 2 plan, such as #7. For comparison to a case with a significant amount of land disposal #8 would do which, at level 2 puts land disposal at its greatest presumed advantage.

In each case we should ask for monthly flow patterns in each river and affected tributary; for evidence that underlies the biological environment in the streams and Lake Erie, including added species anticipated; and for evidence that underlies the aesthetic condition of the streams. Because storm water control and treatment is of such considerable expense, it seems appropriate to make its impacts stand out clearly from the waste water treatment. It could be that the present N. E. Plan with storm water treatment could come closer to our goals than level 1 or level 2 plans with waste treatment alone.

It may well be that the assessments asked for above cannot be made without demonstration projects. It seems likely in any event that the public will not buy either land disposal or storm water treatment without demonstration of their virtues. Thus we should ask the Corps to fund demonstrations of each in such a way that their efficacy may be established in the District. This should include return to the land of entrapped sediments in the storm water treatment. In the meanwhile, proceeding along on the general base of the N. E. Plan will not close the option of subsequent more massive land disposal systems should they prove their merits.

Evaluators indicated such high virtues for strip mine disposal of organic sludge that modifications of the N. E. Plan to include this technique are probably warranted.

To date I have been unable to extract a solid cost comparison between the methods of sludge disposal examined by the Corps; a cost determination, based upon sludges produced by the N. E. Plan, and the N. E. Plan carried to level 1 should be made; if significant changes in the character of sludges produced is anticipated as higher treatment levels are reached, it would be well to make sure such changes do not alter the anticipated beneficial results of strip land disposal.

We discussed the implications of implementation methods and management needs, and Ohio's desire to obtain a clear picture of the Corps thinking at the highest levels as to their future participation in such activity. Looked at broadly this may be the most important issue we must face. To a great degree this is a philosophic question rather than, say, an economic one. If we should decide such an issue in short term apparent economic gains to Ohio and ignore the more far reaching question of appropriate areas of Federal involvement we would in my judgement be missing the really critical issues. I think it of extreme importance to Ohio, to the Country and to the people of each that the Corps be asked to state its own position firmly on this matter and at the top level of the Army.

I hope these comments may be of help to you. Should you wish further discussion on any of these points, please let me know.

Sincerely,

George

George H. Watkins
Secretary-Treasurer

GHW:kep

cc: Art Woldorf